TOTAL DUST CONCENTRATION AND FACTORS ASSOCIATED WITH RESPIRATORY SYMPTOMS AMONG HOME-BASED CLOTH WORKERS

THITIPORN SONGKROH

A THESIS SUBMITTED IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR
THE DEGREE OF MASTER OF NURSING SCIENCE
(COMMUNITY HEALTH NURSING)
FACULTY OF GRADUATE STUDIES
MAHIDOL UNIVERSITY
2003

ISBN 974 – 04 – 4026 - 6

Thesis

entitled

TOTAL DUST CONCENTRATION AND FACTORS ASSOCIATED WITH RESPIRATORY SYMPTOMS AMONG HOME-BASED CLOTH WORKERS

Thitiporn Songkroh

Miss Thitiporn Songkroh
Candidate

Lect. Wantana Maneesriwongul, D.N.Sc.
Major-Advisor

Prof. Sawang Saenghirunvattana, M.D.,M.B.A.
Co-advisor

Assoc.Prof. Rassmidara Hoonsawat, Ph.D.
Dean
Faculty of Graduate Studies

Assoc.Prof. Yuwadee Luecha, Ed.D.
Chairperson
Master of Nursing Science
Faculty of Medicine Ramathibodi Hospital

Thesis

entitled

TOTAL DUST CONCENTRATION AND FACTORS ASSOCIATED WITH RESPIRATORY SYMPTOMS AMONG HOME-BASED CLOTH WORKERS

was submitted to the Faculty of Graduate Studies, Mahidol University
for the degree of Master of Nursing Science (Community Health Nursing)

on

September 17, 2003

....
Miss Thitiporn Songkroh
Candidate

....
Lect. Wantana Maneesriwongul, D.N.Sc.
Chairperson

....
Prof. Sawang Saenghirunvattana, M.D.,M.B.A.
Member

....
Assist. Prof. Jariya Wittayasooporn, DNS.
Member

....
Assoc. Prof. Chalermchai Chaikittiporn,
Dr.P.H. (Epidemiology)
Member

....
Assoc.Prof. Rassmidara Hoonsawat,
Ph.D.
Dean
Faculty of Graduate Studies
Mahidol University

....
Prof. Prakit Vathesatogkit,
M.D., ABIM, FRCP.
Dean
Faculty of Medicine, Ramathibodi Hospital,
Mahidol University

ACKNOWLEDGEMENT

I would like to express my appreciation to Dr. Wantana Maneesriwongul, my major-advisor for her assistance, encouragement, and continuous invaluable guidance throughout this thesis. I also grateful to Professor Sawang Saenghirunvattana, my co-advisor, for his excellent guidance, and validation of this research questionnaire. I would like Assistance Professor Jariya Wittayasooporn and Associated Professor Chalermchai Chaikittiporn for their facilitation and comments.

I am also grateful to thank Head of Bansang Health Care Center, Mr. Thongchai Piyatussri, and his members for their assistance, facilitation, and valuable advice on data collection period. Moreover, I thank to all of Bansang villagers who participated in this study for cooperation.

I am also a deep thanks to Miss. Somjit Toolatong, my best friend, for her helpful throughout data collection period. Moreover, I am thankful to Mr.Paitoon Udomsakulrat for computer equipment supported.

Finally, I would like to thank my mother, father, sisters, brothers and sons, Junior Komchan and Junior Patid, for their support and encouragement, which have inspired me to reach a goal.

Thitiporn Songkroh.

TOTAL DUST CONCENTRATION AND FACTORS ASSOCIATED WITH RESPIRATORY SYMPTOMS AMONG HOME-BASED CLOTH WORKERS

THITIPORN SONGKROH 4336887 RACN/ M

M.N.S. (COMMUNITY HEALTH NURSING)

THESIS ADVISORS: WANTANA MANEESRIWONGUL, D.N.Sc., SAWANG SAENGHIRUNVATTANA, M.D., M.B.A. (MANAGEMENT)

ABSTRACT

The objective of this cross-sectional research was to measure total dust concentration exposure, measure size of dust particles that home-based cloth workers exposed, examine associations between home-based cloth work and respiratory symptoms, examine associations between risk factors and respiratory symptoms, and examine associations between dust protective actions and respiratory symptoms among home-based cloth workers in Bansang subdistrict, Bangpa-in district, Ayutthaya province. The sample consisted of 129 home-based cloth workers (exposure group) and 129 non-home-based cloth workers (non-exposure group). Data were obtained by observation and structured interview about background characteristics, risk factors, dust protective actions, and respiratory symptoms. Along with this study, total dust concentration and size of dust particles were collected and analyzed. The data were analyzed using descriptive statistics, Chi-square test, t-test, and Odds ratio. The findings revealed that there were statistically significant associations between home-based cloth work and respiratory symptoms (cough, phlegm production, chest tightness, nasal congestion, wheezing, and respiratory symptom(s)) [OR= 3.46 (1.40-8.77), 4.26 (1.90-9.75), 6.98 (3.08-16.24), 3.84 (2.15-6.89) and 4.61 (1.82-12.18), respectively]. There was a statistically significant association between the level of total dust concentration exposure and cough [OR= 3.12 (1.13-8.84)]. There were statistically significant associations between dust protective action (cleansing workplace and devices after work) and respiratory symptoms (cough, phlegm production, and chest tightness) [OR= 2.82 (1.04-7.68), 2.99 (1.23-7.28), and 3.16 (1.25-8.10), respectively]. The finding of this study could be useful as a guideline in planning the prevention of occupational respiratory symptoms among home-based cloth workers.

KEY WORDS: HOME-BASED CLOTH WORKER, RESPIRATORY SYMPTOMS, OCCUPATIONAL HEALTH NURSING

115 p. ISBN 974 – 04 – 4026 – 6

ความเข้มข้นของฝุ่นและปัจจัยที่มีความสัมพันธ์กับอาการทางระบบหายใจในกลุ่มผู้รับงานผ้าไปทำที่บ้าน
(TOTAL DUST CONCENTRATION AND FACTORS ASSOCIATED WITH RESPIRATORY SYMPTOMS AMONG HOME-BASED CLOTH WORKERS)

ฐิติพร สงเคราะห์ 4336887 RACN/M

พย.ม. (การพยาบาลอนามัยชุมชน)

คณะกรรมการควบคุมวิทยานิพนธ์: วันทนา มณีศรีวงศ์กูล, D.N.Sc.,
สว่าง แสงหิรัญวัฒนา, พ.บ., M.B.A.(Management)

บทคัดย่อ

การวิจัยเชิงพรรณนาแบบภาคตัดขวางครั้งนี้ มีวัตถุประสงค์เพื่อวัดความเข้มข้นของฝุ่นและขนาดอนุภาคของฝุ่นที่คนงานที่รับผ้าไปทำที่บ้านสัมผัสในการทำงาน ศึกษาความสัมพันธ์ของการทำอาชีพรับงานผ้าไปทำที่บ้าน ปัจจัยเสี่ยงในที่ทำงานและพฤติกรรมการป้องกันฝุ่นขณะทำงานกับอาการทางระบบหายใจในกลุ่มคนงานที่รับงานผ้าไปทำที่บ้านในตำบลบ้านสร้าง อำเภอบางปะอิน จังหวัดพระนครศรีอยุธยา กลุ่มตัวอย่างที่ศึกษาเป็นประชากรทั้งหมดที่รับงานผ้าไปทำที่บ้านที่อาศัยอยู่ในชุมชนบ้านสร้างจำนวน 129 คน(กลุ่มเสี่ยง) และประชาชนที่ประกอบอาชีพอื่นๆ 129 คน(กลุ่มไม่เสี่ยง) เก็บรวบรวมข้อมูลจากการสังเกตและสัมภาษณ์ตามแบบสอบถามที่ผู้วิจัยสร้างขึ้นเกี่ยวกับข้อมูลส่วนบุคคล ปัจจัยเสี่ยงในการทำงาน พฤติกรรมการป้องกันฝุ่นในขณะทำงานและอาการทางระบบหายใจ ในขณะเดียวกันมีการเก็บตัวอย่างฝุ่นโดยเครื่องเก็บตัวอย่างแบบติดตัวบุคคลเพื่อวิเคราะห์ความเข้มข้นของฝุ่นในขณะทำงานด้วย ผลการศึกษาพบว่า การทำอาชีพรับงานผ้าไปทำที่บ้านมีความสัมพันธ์อย่างมีนัยสำคัญทางสถิติกับอาการทางระบบหายใจคือ อาการไอ มีเสมหะ แน่นหน้าอก คัดจมูก หายใจมีเสียงวี้ดและอาการทางระบบหายใจอย่างน้อยหนึ่งอาการตามที่กล่าวมาข้างต้นโดยค่าOR= 3.46 (1.40-8.77), 4.26 (1.90-9.75), 6.98 (3.08-16.24), 3.84 (2.15-6.89) และ 4.61 (1.82-12.18)ตามลำดับ ระดับความเข้มข้นของฝุ่นที่สัมผัสมีความสัมพันธ์อย่างมีนัยสำคัญทางสถิติกับอาการไอ โดยค่า OR= 3.12 (1.13-8.84) การทำความสะอาดอุปกรณ์และพื้นที่การทำงานหลังเลิกงานมีความสัมพันธ์อย่างมีนัยสำคัญทางสถิติกับอาการไอ มีเสมหะและอาการแน่นหน้าอก โดยค่า OR= 2.82 (1.04-7.68), 2.99 (1.23-7.28) และ 3.16 (1.25-8.10) ตามลำดับ ผลการศึกษาเป็นประโยชน์สามารถใช้เป็นแนวทางในการเฝ้าระวังและป้องกันอาการทางระบบหายใจในกลุ่มผู้รับงานผ้าไปทำที่บ้านต่อไป

115 p. ISBN 974-04- 4026 - 6

CONTENTS

CONTENTS (CONT.)

LIST OF TABLES

LIST OF TABLES (cont.)

Table **Page**

LIST OF FIGURES

Figure **Page**

LIST OF PICTURES

CHAPTER I
INTRODUCTION

Background and Rationale

Early stage occupational respiratory disease is difficult to be detected because its common symptoms are usually non-specific and similar to those of other respiratory diseases. However, differential diagnosis of this disease can early be done by taking history of occupational hazardous exposures in their working environment (Bouhuys & Zuskin, 1980: 43; Sawang Seanghirunvattana, B.E.1994: 49-50; Schachter, 1994: 215; Pornchai Sitthisarunkul, B.E.2542: 62-65; and Taylor & Picering, 1994: 725). In Thailand, occupational diseases' surveillance reported by Occupational Health Care Division, Health Department, Ministry of Public Health does not include all occupational diseases in every occupational groups, so some diseases have not been monitored. The workers suffering from early stage occupational respiratory disease were often misdiagnosed, and usually received just symptomatic treatment. Thus, their early symptoms can further progress to chronic respiratory diseases which consequently decreased work efficacy (Somkiet Wongtim, In Sawang Seanghirunvattana, B.E.2542: 240).

According to Schachter (1994), there was no evidence of developing toxicants of cotton dust's end products. However, number of studies reported that inhalation of 5-10 micron cloth dust can cause acute or chronic respiratory diseases (Banks & Wang, 2000; Boondesh, 1992; Borribunetrup, 1994; Chaikittiporn, 1987; Chanlett, 1979: 217-226; Danse, 1996: 63-69; Kampen & Merget, 2000; Maizlish, 2000: 340-342; Merchant, Halprin & Hudson, 1975: 222-229; Rosenstock & Cullen, 1986: 15-25; Rylander & Jacobs, 1994: 1-11; Toren et al., 2000; and Utell & Samer, 1993: 1058-1066). In addition, many studies revealed that inhalation of cotton dust affected to decreasing pulmonary function or provoked respiratory symptoms among textile workers (Banks & Wang, 2000; Barnes, 1989; Bernstein, 1982; Borribunetrup, 1994;

Bouhuys & Zuskin, 1980; Chaikittiporn, 1987; Cheanbumrung, 1982; Christiani, 2001; Goldstein & Gotsch, 1994; Guenter, C.A., Welch & Hog, 1978; Keith, Morgan & Seaton, 1975; Levy & Wegman, 1988; Merchant, 1973; Nicholls & Skidmore, Merget & Baur, 2000). Wongtim and colleagues (1999: 241) also found that the garment industrial workers were increasingly ill with allergic rhinitis and asthma.

There are three main home-based cloth work areas in Ayutthaya: Bangpa-in, Wangnoy, and U-Tai district (Ayutthaya Provincial Public Health Office, 2002). Among these, the largest cloth work area is Bansang subdistrict of Bangpa–in district. There are approximately 180 home-based cloth workplaces where cloth products were made by about 200 workers work in Bansang's home-based work areas (Bansang Health Care Center, 2002). The productions of these work are sport wears, infant wears, rugs, and cloth-woven carpet, etc. The waste products of this working process are many small pieces of cloths and cloth dust which is cloudy in their home.

According to Ayutthaya Provincial Public Health Office, The report of morbidity rate of respiratory diseases in Ayutthaya province in 1999 to 2001 shown that the morbidity rate of respiratory diseases of Bansang subdistrict was higher than morbidity rate of respiratory diseases of Ayutthaya province and Bangpa-in district. (Figure 1.) The report of Bansang Health Care Center in January 2002 to August 2002 shown that patients with respiratory diseases was higher than other diseases and age group of these patients was labor groups. (Figure 2.)

As the cloth work is done in their dwellings, there are many household members living in home-based cloth workplaces including children and elderly at risk from cloth dust, especially in poorly ventilated housing. While respiratory 's defense mechanism of children is immature and that of elderly is to some degree impaired (Berne & Levy, 1993: 610-611; Cherniack, Altose & Kelsen, 1988: 641-642; Mangino, 2000: 349-354; and Martini et al., 1998: 856), they are prone to developing respiratory diseases. Although cloth dust exposure can lead to occupational respiratory diseases, workers and household members are not aware of this harm. They continue to work and live in their home-based cloth workplaces without any precaution. The review of Occupational Health Division found that previous occupational health research of cloth workplaces usually conducted among workers working in cloth industry (Ahmed, 2001; Chaikittiporn, 1987; Douwes, 2000; Sirajuddin, 2001; Toren, 2000; and Somkiet Wongtim, In Sawang Seanghirunvattana, B.E.2542: 240). Since there is no existing research among home-based cloth workers, it is not known how much they are at risk for occupational respiratory diseases and their preventive behaviors.

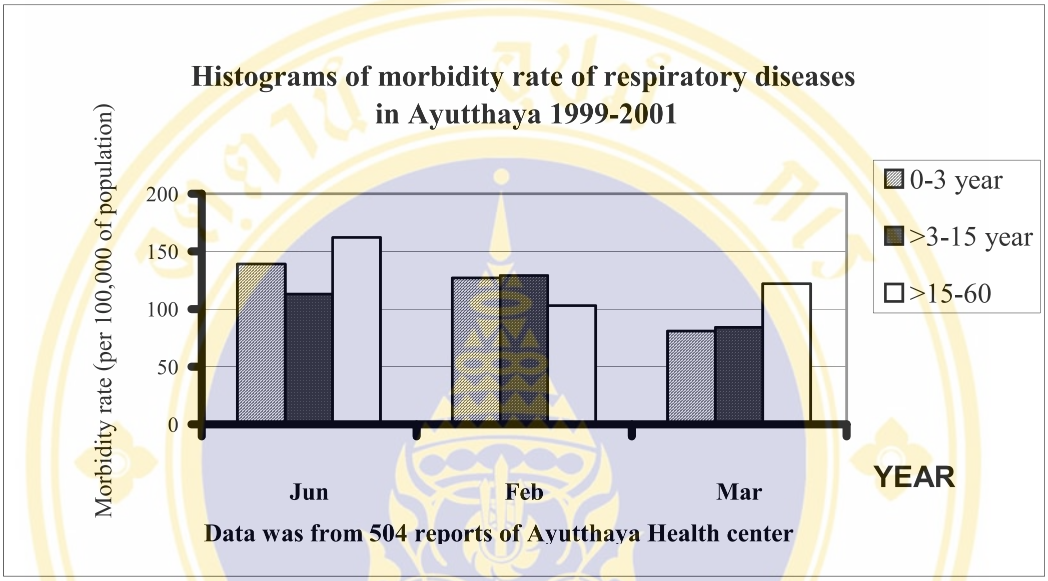


Figure 1 Histogram of Morbidity rate of diseases in Ayutthaya 1999-2001

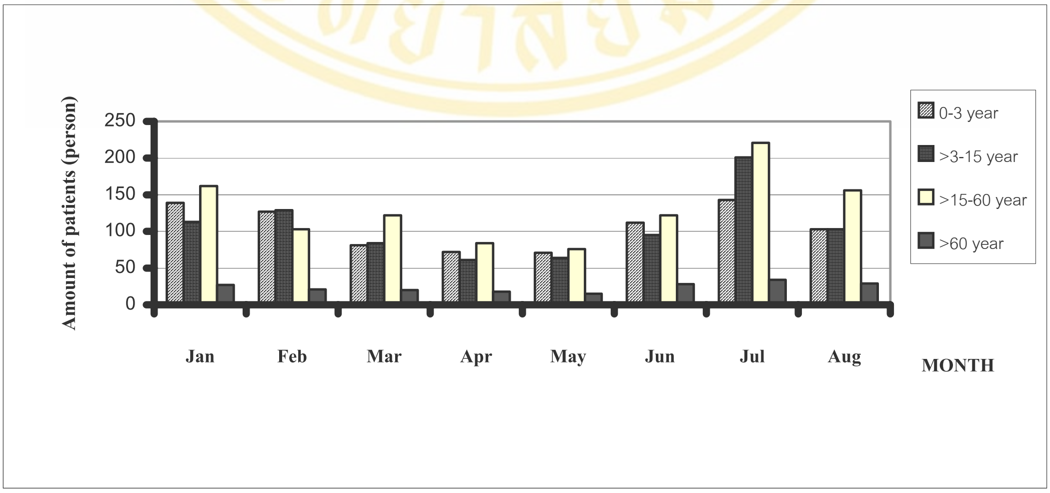


Figure 2 Histrogram of respiratory diseases by age groups at Bansang Health Care Center on January to August 2002

This is a cross-sectional study to explore associations between home-based cloth work, risk factors, and dust protective actions with respiratory symptoms among home-based cloth workers in Bansang subdistrict of Bangpa-in district, Ayutthaya province. Along with this study, total dust concentration and size of particles in home-based cloth workplaces will be collected during a worker's working period by using a personal dust sampler which is an electronic air pump equipment to remove dust particles from the air stream by particle inertia (Jensen and O'Brien, 1993: 537-561). These findings will indicate how much exposure to cloth dust among these workers.

Since there are many small home-based cloth workplaces in Thailand, results of this study will be useful as baseline data for health care providers to plan occupational respiratory diseases preventive programs among these home-based cloth workers.

Research Framework

. The most common symptoms of respiratory problems among textile workers are cough (Kilburn, 1985; Morgan & Seaton, 1986 and Schilling, 1956), phlegm production (Kilburn, 1985; and Robinson, 1994), chest tightness (Kilburn, 1985; and Morgan & Seaton, 1986). Other symptoms were found among textile workers (non-byssinosis'symptom) are nasal congestion (Cheanbumrung, 1982; Hogen, 1993: 188-190; and Raza et al, 1999) and wheezing (Schachter, 1994:215). Other factors which associated with byssinosis are size of dust particles (Chaikittiporn, 1979), level of hazardous exposure (Cuwichian Borribunetrup, B.E. 2537; Chaikittiporn, 1979; Lu et al, 1987; and Ong et al, 1987), and duration of hazardous exposure (Lee et al, 1997; Li et al, 1987; and Raza et al, 1999).

Cotton dust can caused acute or subacute airway smooth muscle contraction, mucus production, and airway inflammation in the form of edema and chemotaxis of cell into the airway tissue. The subacute changes have been associated with hyperreactivity and sustained airway obstruction (Schachter, 1994: 210). Schilling (1956) found that cotton dust can changed in pulmonary function.

Dust protective actions can decreased respiratory symptoms including using respiratory protective devices (Coiton, 1993: 619-620; Levy & Wegman, 1988: 45-46; Lu, P.L., et al., 1987; Obase, et al., 2000; Srichant Uthayopas, B.E. 2536; and Sujinda

Jarupat, B.E. 2545), body bathing (Chanlett, 1979: 227-228), cleansing workplace (Chanlett, 1979: 227-228), separation of operation area (Pairoj-Boriboon, 1989: 84), and ventilation management (Mutchler, 1973: 573-574).

This study will focus on factors associated with respiratory symptoms among home-based cloth workers. Research framework of this study is illustrated in Figure 3.

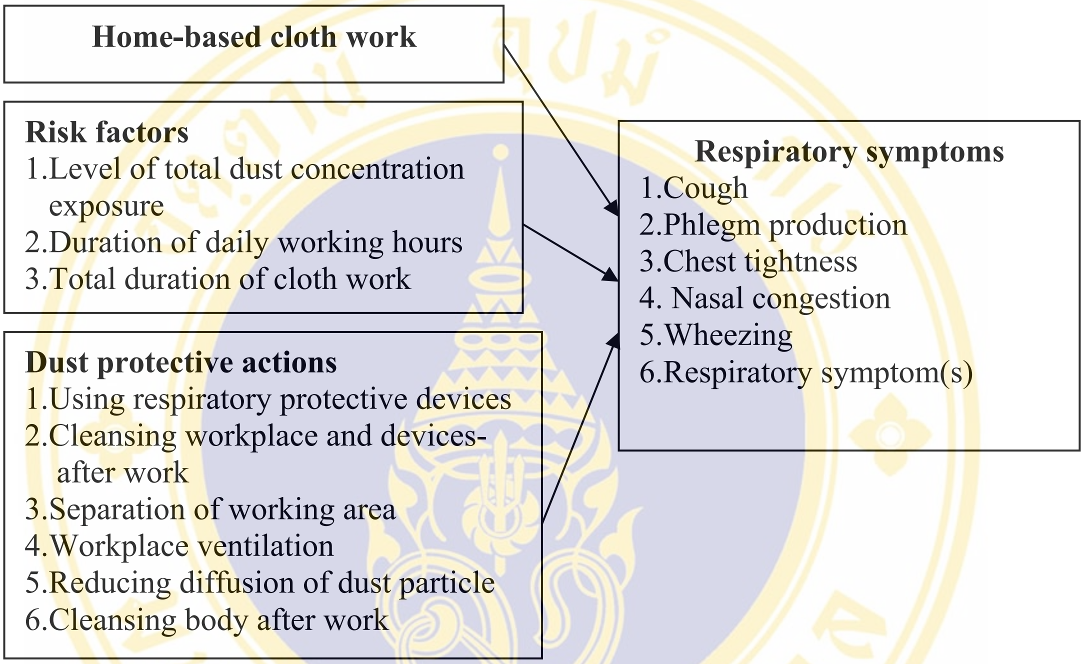


Figure 3. Research framework of this study

Objectives of Study

1. To measure total dust concentration exposure among home-based cloth workers.
2. To measure size of dust particles that home-based cloth workers exposed.
3. To examine associations between home-based cloth work and respiratory symptoms.
4. To examine associations between risk factors and respiratory symptoms among home-based cloth workers.
5. To examine associations between dust protective actions (using respiratory protective devices, cleansing workplace and devices after work, separation of working area, workplace ventilation, reducing diffusion of dust particle, and

cleansing body after work) and respiratory symptoms among home-based cloth workers.

Hypotheses

1. There are significant associations between home-based cloth work and respiratory symptoms (cough, phlegm production, chest tightness, nasal congestion, wheezing, and respiratory symptom(s)).
2. There are significant associations between risk factors (level of dust particle exposure, duration of daily working hours, and total duration of cloth work) and respiratory symptoms (cough, phlegm production, chest tightness, nasal congestion, wheezing, and respiratory symptom(s)) among home-based cloth workers.
3. There are significant associations between dust protective actions (using respiratory protective devices, cleansing workplace and devices after work, separation of working area, workplace ventilation, reducing diffusion of dust particle, and cleansing body after work) and respiratory symptoms (cough, phlegm production, chest tightness, nasal congestion, wheezing, and respiratory symptom(s)) among home-based cloth workers.

Scope of the Study

This study is a cross-sectional study exploring associations between home-based cloth work, risk factors, and dust protective actions with respiratory symptoms among home-based cloth workers in Bansang subdistrict Bangpa- in district Ayutthaya province. Data was collected in December 2002 and March 2003.

Definition of Terms

Sex is defined as male or female.

Age is defined as the period in years between the reported date of birth and the date of data collection. Less than six months will be not counted, but six months or over will be counted as one year.

Years of education is defined as number of years that the respondent had received education. This will be calculated from reported educational level, assuming that there is no repeated year. For example, senior high school is equivalent to 12 years of education.

Monthly income is an amount of money that the respondent earns per month.

Past respiratory illness is a respiratory illnesses that the respondent had within the past year (1-year). These respiratory illnesses can present symptoms that are similar to occupational respiratory symptoms, such as bronchitis, pulmonary tuberculosis, asthma, pneumonitis, and lung cancer.

Cigarette smoking history is a habit of respondent regarding cigarette smoking in the past. Operationally, cigarette smoking history is classified into three groups: smoker, recent smoker, and non-smoker. Smoker refers to the respondent who has smoked cigarette or kept away from cigarette smoking less than three months to the date of data collection. Recent smoker refers to the respondent who has kept away from cigarette smoking over three months to the date of data collection. Non-smoker refers to the respondent who has not smoked cigarette. All respondents who ever smoke were asked how long he/she had smoked cigarette.

Occupation is an occupation that the respondent has it for main income on the date of data collection. Operationally, type of occupation is classified into six groups that are home-based cloth worker, government service, agriculture, merchant, employee, and miscellaneous. The respondent who answered other occupations (non home-based cloth work) were asked about his/her past occupation and how long he/she done it.

Home-based cloth work is an occupation that a respondent makes cloth products, such as sport wears, children's wears, cloth rugs, and cloth-woven carpet. Operationally, home-based cloth work will be classified into two groups that are home-based cloth work and non home-based cloth works (other occupation). The respondent who is classified into home-based cloth work group must do this occupation for at least 6 months to the date of data collection. Other occupations are classified to non home-based cloth work.

Type of production is defined as a kind of home-based cloth work's product that are sport wears, children's wears, cloth rugs, and cloth-woven carpet.

Level of total dust concentration exposure refers to level of total dust concentration which were measured by the industrial hygienist at the Silapakorn

University with GILIAN ® (Gil Air-5 model). Eleven case studies were collected to represent and learn about all of home-based cloth workers' dust exposure during working hours. Level of total dust concentration exposure was categorized into low and high levels. Operationally, level of total dust concentration exposure is classified into two categories based on findings of total dust concentration measurement from the report of 11 case studies: low level of total dust concentration exposure and high level of total dust concentration exposure. Low level of total dust concentration exposure happens to home-based cloth workers whose workplace had total dust concentration lower or equal to 5 mg/m^3 . High level of total dust concentration exposure happens to home-based cloth workers whose workplace had total dust concentration over 5 mg/m^3. According to the National Institute for Occupational Safety and Health (1977), respirable dust particles concentration (1-10 micron) in safe workplace should not exceed 5 mg/m^3. In this study, workplaces of sport wear in good ventilation, cloth rug and woven carpet in good ventilation, infant wear in good and poor ventilation, and cloth cutting in good ventilation have low level of total dust concentration exposure. While workplaces of sport wear in poor ventilation, cloth rug and woven carpet in poor ventilation, and cloth cutting in poor ventilation have high level of total dust concentration exposure.

Duration of daily working hours is defined as number of working hours per day that a respondent does home-based cloth work. Operationally, duration of daily working hours is classified into two groups: "8 hours per a day or less" and "over 8 hours per a day". The respondent who has daily working hour more than 8 hours is considered to have higher risk to provoke respiratory symptoms. This criteria of 8 working hours was based on Air Quality Standard of Labor Law of Thailand.

Total duration of cloth work is defined as total number of years that the respondent has ever works in home-based cloth work or others associated cloth work. Operationally, total duration of cloth working is classified into two groups: "6 years or less" and "over 6 years". The respondent who has a longer duration of cloth working is considered to have higher risk to provoke respiratory symptoms (Bouhuys and Zuskin,1980; Heederik and Smid, 1994 and Schilling, 1994).

Dust protective action is an action that the home-based cloth worker practice to protect cloth dust in his/her workplace. They are using respiratory protective devices, cleansing workplace and devices after work, and separation of working area, workplace ventilation, reducing diffusion of dust particles, and cleansing body after work.

Using respiratory protective devices is usage of a respiratory protective device(s) by a home-based cloth worker. The respiratory protective devices are such as simple cloth mask covering nose and mouth or other kinds of mask. Operationally, using respiratory protective devices is classified into always using, sometimes and never use respiratory protective device during cloth work.

Cleansing workplace and devices after work is reported practice to clean workplace as well as devices in order to prevent spreading of dust in home-based cloth workplace. Operationally, cleansing workplace and devices after work is classified into always cleansing, sometimes and never cleansing workplace and devices after work.

Separation of working area is separation of working area from living area to prevent cloth dust spreading in living area. Operationally, separation of working area is classified into separation of working area and never separation of working area.

Workplace ventilation is practice to ventilate home-based cloth workplace. Operationally, workplace ventilation is classified into good and poor workplace ventilation.

Reducing diffusion of dust particles is decreasing diffusion of dust particles in home-based cloth workplace. In this study, home-based cloth worker who turn on an electric fan into his/her working is considered as non reduced diffusion of dust particle. Operationally, reducing diffusion of dust particles is classified into always reducing, sometimes and never reducing diffusion of dust particles.

Cleansing body after work is cleansing home-based cloth worker's body and changing cloth after work to wash away cloth dust. Operationally, cleansing body after work is classified into always cleansing, sometimes and never cleansing body after work.

Respiratory symptom(s) refer to reported past and present respiratory symptoms. These symptoms are based on literature reviewed that documented among textile workers. They are cough, phlegm production, chest tightness, nasal congestion, and wheezing (Danse, 1991: 65-68; Morgan & Seaton, 1975: 275-283: and Parkes, 1994: 724-735).

Cough is a complex physical mechanism of the pulmonary defense that protects the lungs from injuries. It is a normal reflex and it can also be a manifestation of pulmonary disease. In this study, cough refers to a respiratory symptom, which occurs after waking in the morning. Operationally, this will be classified into presence of cough and absence of cough.

Phlegm production is a defense reaction of respiratory tract due to inhalation of irritant or airway inflammation. This symptom occurs in patients with chronic bronchitis. In this study, phlegm production is a symptom that occurs after waking in the morning. Operationally, phlegm production is classified into presence of phlegm production and absence of phlegm production.

Chest tightness is a respiratory symptom characterized by substernal discomfort and difficulty breathing. In this study, this respiratory symptom refers to feeling of chest tightness or breathing difficulty during cloth work. Operationally, chest tightness is classified into presence of chest tightness and absence of chest tightness.

Nasal congestion is a symptom of rhinitis manifestation caused by inhalation of irritant. In this study, nasal congestion refers to a symptom of nasal congestion or nasal catarrh that usually suffer him/her during or after cloth work. Operationally, nasal congestion is classified into presence of nasal congestion and absence of nasal congestion.

Wheezing is a symptom of chest illness caused by bronchial constriction. In this study, this symptom will be assessed by reported hearing sound of wheezing without getting a cold. Operationally, wheezing is classified into presence of wheezing and absence of wheezing.

Respiratory symptom(s) refer to presence of at least one of the following symptoms: cough, phlegm production, chest tightness, nasal congestion, or wheezing.

Expected Research Outcome and Benefits

1. Findings of this study can be used as baseline data for health care providers to plan for respiratory illness protective programs to prevent or reduce respiratory illness among home-based cloth workers in Bansang sub-district Bangpa-in district, Ayutthaya province.

2. The results of this study can guide further nursing research on occupational risk factors of respiratory illnesses, and protective actions among home-based cloth workers.

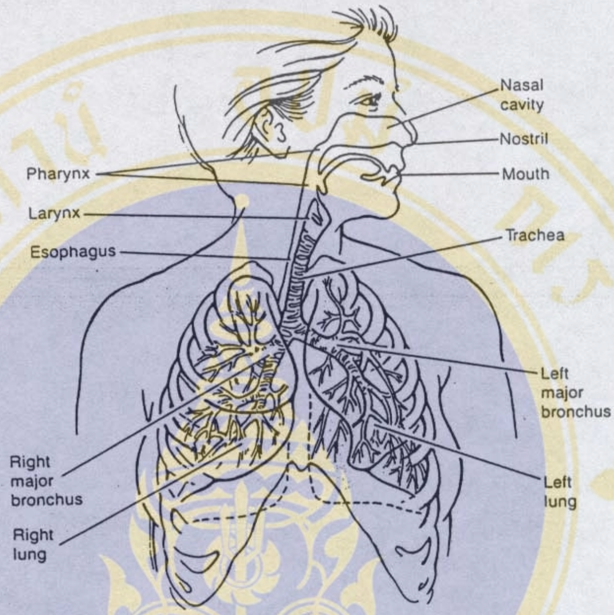
CHAPTER II
LITERATURE REVIEW

The theoretical and empirical literature for this study about the associations between home-based cloth work, risk factors, dust protective action and respiratory symptoms among home-base cloth workers is provided on the following topics: (1) physiology of respiratory system and defense mechanisms; (2) particulate, measurement of particulate exposure, and air quality; (3) associations between occupational respiratory symptoms and hazardous exposure in workplace; (4) associations between duration of hazardous exposure and occupational respiratory symptoms; (5) occupational respiratory protective actions; and (6) cloth home-base work process.

Physiology of Respiratory System and Defense Mechanisms

Physiology of Respiratory System

The respiratory system is composed of the structures involved in the exchange of gases between the blood and external environment. During breathing, inspiration is the movement of air from the external environment through the airways into the alveolus, in the reversible, expiration is movement in the opposite direction. This system serves other functions of man body (Martini, 1998: 816-817; Tortora, & Anagnostakos, 1984: 541-555; and Vander, 1990: 428-429). The nose, mouth, pharynx, and larynx are termed the upper airways which are as the route of air or food passage. They are not only respiratory function. The airways are divided into two zone include: (1) the conducting zone – that are from the top of the trachea to the beginning of the respiratory bronchioles – which contains no alveoli and gas-blood exchange does not occur, and (2) the respiratory zone – that are from the respiratory bronchioles on down – which contains alveolus and across that gas exchange occurs. The respiratory tract constructions are shown in Figure 4.



(Vander et al., 1990: 429)

Figure 4 Respiratory tract

Respiratory Defense Mechanism

In the atmosphere, man exposed the entire respiratory tree to any toxic or pathogenic agents. Respiratory function was maintained by effective defense mechanisms (Aas, 1993; Cherniack et al.,1988; Danse, 1991; Kaye et al.,1985; and Vander, 1990).

Raffle and colleagues (1987) recommended that the body is defendant against dust at four level including: (1) the upper airways filter, (2) the lower airways filter, (3) macrophage clearance to the airways, and (4) macrophage segregation of dust particles and clearance via the lymphatic.

The Upper Airways Filter

The hairs and the folds of the mucosa over the turbinate direct the airflow through the nose so that particle over 15 micron in diameter hit the surface and are carried in the mucus to the pharynx and swallowed. Running of the eyes and nose and sneezing often persuade the person to get away from the dust when the particles are irritant or cause an allergic reaction. At work a certain tolerance may develop. People doing heavy work breathe through their mouths and bypass this protective mechanism which is taken over by the lower airways filter.

The Lower Airways Filter

This part lined by mucociliary epithelium acts as a low resistance filter which removes nearly all of the particles down to about 5 micron and a proportion of those a bit smaller. During inspiration, the particles which are onto the mucus below the bifurcation. They are carried in the mucus back to the larynx, and joined the particles from the upper airways and swallowed (Boondesh, 1992:14;Danse, 1991: 65; and Vander, 1990: 430-433). During deep breathing (hard work), the external air does not reach beyond the mucociliary lined part of airways, pushing ahead of it the air left in the airways at the end of the previous breath. For dust to get beyond the mucus clearance system, it must remain in suspension during several breathe while mixing occurs between thee incoming air and that remaining in the lung. Secretion is provoked for aiding the clearance on the mucociliary lining by goblet cells and the submucosal seromucous glands. If the nerve endings are stimulated by the irritant dust; cough reflex, airways narrowing, and outpouring of secretions from the lower airways and from the eyes and upper respiratory tract are occurred. Prolonged exposure to irritant dust causes hypertrophy of the submucous glands and proliferatio of the goblet cells further and further down the airways. This pathology of chronic bronchitis is often seen in people who smoke tobacco or work in an irritant dusty atmosphere (Bernstein, 1982: 125-127; Boondesh, 1992; Lee et al., 1997: 963-968; and Matheson, 1982: 128-129).

Although the response starts as a protective mechanism, it can become sufficiently severe to interfere with airflow and also to prevent the clearance of infected material from the bronchi, thus increasing the risk of bronchopneumonia and causing gradual loss of lung function.

Martini (1998) suggested that large quantities of airborne particles may overload the respiratory defenses and produce a variety of illness. For example, the presence of irritants in the lining of the conducting passageways can provoke the formation of abscesses that block airflow and reduce pulmonary function, and damage to the epithelium in the affected area may allow irritants to enter the surrounding tissues of the lung.

Cilia is constantly contained the epithelial surfaces through the airways to the end of the respiratory bronchioles toward the pharynx. All the length of the respiratory tract contain the goblet cells in the epithelium and mucus gland which produce a sticky mucus bathes exposed surfaces. A rapid increase in the rate of mucus production in the nasal cavity and paranasal sinuses are generally caused by exposure to unpleasant stimuli such as noxious vapors, large quantities of dust and debris, allergens (Martini et al., 1998: 816-817).

Size of cilia is as about 6 micron long and 0.3 micron in diameter. Each ciliated cell has approximately 200 cilia. Most of cells lining the tracheobronchial tract from the larynx to the terminal bronchioles are ciliated. Cilia beat from 12 to 20 times per second (Cherniack et al., 1988). Ciliary activity can be inhibited by many noxious agents. For example, smoking a single cigarette can immobilize the cilia for several hours. The reduction in ciliary activity may result in lung infection and/or airway obstruction by stationary mucus (Vander, 1991:429-430).

Macrophage Clearance

Particles getting beyond the mucociliary system fall onto the lining of alveolar ducts and alveoli and may be retained . Very small particles (less than 0.5 micron in diameter) sediment is so slowly that only a proportion are caught in this way before being wash out again by the mixing of the alveolar air with clean inspired air. The alveoli, which open directly off the sub terminal airways' being encountered first, catch the bulk of the retained dust.

During the dust touch the walls of terminal airways or alveoli, the cells are stimulated to more producing surfactant by that dust for coating particles. Macrophages moved out from the walls and engulf the particles, and they move back in during fully loaded. Many of the dust particles are dissolved by lysosomal enzyme. By this mechanism, lung can probably clear the retained dust as a result of regular exposure at work of respirable dust. Macrophages are not damaged by the dust, cigarette smoking, or atmospheric pollution outside the workplace. When overload of macrophage system is very heavy, the type II and even type I alveolar lining cells may take on a phagocytic role and help to pick up and remove dust gravitating onto them.

Macrophage Segregation of Dust Particles and Clearance Via the Lymphatic

A result of overload or some property of the dust which damages the macrophages that clearance of dust to the airways broken down. The severity of damage depends on the combined effects of the toxicity and the level of exposure. Prolonged high level of exposure to a dust of low toxicity may in the end produce the same damage as low level exposure to a dust like quartz for a short period. The cells died and the dust picked up by other macrophages which attempt to carry it to the lymph nodes either via the lymphatic in the interlobular septa and under the pleura or blood vessels. Most particles smaller than about 0.5 micron remain suspended in the air (Robinson, 1994: 95-105).

Respiratory Defense Change with Age

The newborn: pulmonary irritant reflexes have been elicited in the neonate, direct stimulation of the lining of the tracheal wall augments respiratory efforts (Staub, 1993: 610).

The young children: Aas (1993:63-68) suggested children are more sensitive to hazardous exposure and immunological harm, more at risk and more exposed to risk than adults. Children build up body mass; most of them are more active than adults. Their respiratory cilia is as ineffective clearance of airways because of hazardous exposure. Intra- household having poor air quality was the risk for having acute respiratory infection among children under five years old.

The elderly: decreasing muscle elasticity of abdomen and thorax involved cough mechanism and sneeze reflex impairment. Decreased in respiratory fluid contributes to thicker secretion and therefore greater difficulty clearing airway (Assantachai, 1999: 255-266; Mangino, 2000: 353; and Martini et al.,1998: 856). Elderly's pulmonary tends to decline above the age of 30 that are depended on aging process (Berne & Levy, 1993: 610-611; Cherniack et al., 1988:641-643; Mangino, 2000: 353; and Martini et al.,1998: 856). In addition to this, aging process also decreased basilar ventilation, decreased number of alveoli, decreased in expansion capacity due to musculoskeletal change in the thorax, loss of lung elasticity with decreased recoil during expiration, increased posterior thoracic curve, and increased rigidity of ribs due to calcification of costal cartilage that can result influence decreased oxygen and carbon dioxide exchange (Mangino, 2000: 353).increased in apical ventilation, reducing overall ventilation and vital capacity, and

Cigarette Smoking Affecting to Respiratory Defense Mechanism

Ciliary activity can be inhibited by noxious agents including smoking. A single cigarette smoking can immobilized the cilia for several hours that may result in lung infection and/or airway obstruction by the stationary mucus, A smoker's early morning cough is an attempt to clear this obstructive mucus from the airways (Cherniack et al., 1988:641-643; and Vander et al, 1990: 429-430).

Occupational Respiratory Symptoms associated with Textile Workers

Pathogenesis

In the early of 18th century, the respiratory symptoms which occurred in the early textile workers had been illustrated by physicians in Europe and America. They found that inhalation of fine dust which include particles of respirable dimension was associated with the clinical syndromes seen in textile workers (Schachter, 1994: 209-212). The most common hypotheses about the pathogenesis of byssinosis include (1) the release of mediators, (2) immunologic mechanisms, and (3) airway reactions to specific cotton dust components. They are described as follow.

The release of mediators has been proposed to explain the mechanism of the acute change seen with exposure to cotton dust. Mediators can cause acute or subacute airway smooth muscle contraction, mucus production, and airway inflammation in the form of edema and chemotaxis of cell into the airway tissue. The subacute changes have been associated with hyperreactivity and sustained airway obstruction. In vitro studies, human tissue exposed to cotton dust leaded to the release of histamine and other mediators (Schachter, 1994: 210)

Immunologic mechanisms have been proposed to explain clinical findings in byssinosis. These are include (1) immediate hypersensitivity (Ig E mediated), (2) immune complex formation, and (3) complement activation.

Clinical Features of Textile worker's Diseases

A disease of textile workers is characterized by the distinctive work-related respiratory complaints as well as changes in pulmonary function. Schilling (1956) standardized the characteristics of respiratory and physiologic changes which could see in those workers were as follow.

Grade 0 : Normal-no symptoms of chest tightness or cough

Grade ½; Occasional chest tightness or cough or both on first day of the working week

Grade1 : Chest tightness on every first day of the work week

Grade2 : Chest tightness on every first day and other days of the work week

Grade3 : Grade 2 symptoms, accompanied by evidence of permanent incapacity from reduced ventilatory capacity

Symptoms other than chest tightness are frequent among textile workers, particularly cough and bronchitis. Chronic respiratory symptoms such as wheezing or chronic bronchitis were much more prevalent in older cotton textile workers (Schachter, 1994: 215). These symptoms probably represent variants of the airway irritation brought on by dust inhalation. Several other symptoms of textile workers which are not related to the initial day of the workweek include:

Mill fever (cotton fever, hemp fever) is associated with fever, cough, chills and rhinitis that occurs with the workers' first contact with the mill or with return after a prolonged absence. Chest tightness does not appear to be associated with this syndrome.

Weaver's cough is primarily an asthmatic condition characteristically associated with fever; it occurs in both new and senior workers. The symptoms can persist for months.

Mattress makers' fever is characterized as an acute outbreak of fever and constitutional symptoms, including retrosternal discomfort in workers using low-grade cotton.

Occupational Respiratory Symptoms Related Hazardous Exposure in Workplace

Organic dusts are complex agents that induce a variety of pathophysiological change whose nature and severity depend upon the agent, the host, and the stage of disease (Robinson, 1994: 95-97). When they are present as dust, many material cause allergic reactions in susceptible people, which can be quite severe, usually involve the skin, respiratory system, and gastrointestinal system. Some of allergic reaction appearances are dermatitis, hay fever, asthma, and hives. Usually, the worker is subjected to a series of exposure without any reactions; during this time, sensitization is built up. This exposure can occur continuously for years. Then, at the end of each individual incubation period, a reaction occurs. Under this condition, an allergic person can work without incident for long periods of time (Hogan, 1993:188-190).

This is in accordant with Robinson's (1994) described that inhaled organic dusts usually induce respiratory tract inflammation which are in both the airway and the alveolus. In airway, clinical syndrome of bronchitis is induced by resulting of mucous secretion and edema. Bronchitis may be simple or chronic depend on mucous hypersecretion presentation, or airway damage/ fixed, respectively. On cell reaction during organic dust exposure that a number of organic dusts may exhibit inflammatory stimulation activities. Organic dust products can directly contribute to a clinical picture of asthma by causing bronchoconstriction. In conclusion, the lung respond to the inhalation of organic dusts in a variety of ways, depending upon the nature of the dust, the duration and intensity of exposure, and the reactively of the host.

Many occupational respiratory symptom studies revealed the relationship between hazardous exposure in their workplace and respiratory symptoms are as follow:

According to Cheanbumrung (1982), the prevalence of cotton dust allergies in cotton mill workers as oppose to people who do not work in this occupation revealed that there was a significant relationship between dust concentration and prevalence of cotton dust allergies. Kilburn (1985) also releaved that chronic organic dusts exposure involved to pulmonary function reduced and acute respirable illness including bronchoconstriction, cough, purulent sputum, shortness of breath (Morgan & Seaton, 1986), chronic bronchitis, respiratory symptoms of persistent cough, chronic production of phlegm, chest tightness, wheezing, breathlessness, and eye and nasal symptoms (Raza et al, 1999).

On one hand, Kim and colleagues (1999:Abstract) postulated that inhalation of cellulase could induce IgE-mediated bronchoconstrictions in employees working in the textile industry. The patients had atopy and strong positive responded to cellulase extraction skin prick tests. Bronchoprovocation test shown and early asthmatic response to cellulase extract among textile industrial workers. Moreover, Moscato and colleagues (1999) also found that cessation of exposure to the offending agent resulted in a decrease in asthma severity among the occupational asthma.

There was significantly associated between pulmonary function test and duration of cotton dust exposure among textile workers (Chaikittiporn, 1987; Christiani et al, 2001: Abstract; Raza et al, 1999: Abstract).

Among the workers who exposed wood chip and mulch dust, occupational organic dust exposure caused the acute pulmonary inflammatory response of organic dust toxic syndrome (ODTS) and developing occupational asthma (Wintermeyer et al, 1997; Douwes et al, 2000).

In blasting, crushing and grinding activities area at Tambon Narpralan, Chalermprakeat District, Saraburi Province, Noppamas Hrimthepatip (B.E. 2542) revealed that there was statistically significant positive association between pulmonary function and concentration of particulate matter less than 10 micron (PM-10). The increase in duration of PM-10 exposure of subjects was significantly associated with higher rates of pulmonary function deterioration.

This is in accordant with Heederik and Smid's (1994) described on acute effects of grain dust on the respiratory system included eye and nasal irritation, cough, phlegm, wheezing, and shortness of breath. These symptoms could be at least partly reversible during the lay-off period among grain workers. Lee (1997) also found that a number of years in the industry related to respiratory symptoms including cough, phlegm, hemoptysis, dyspnea, wheezing, chest tightness, nose or throat irritation, eye irritation, and sinus trouble among 215 newspaper pressroom workers. Finally, Toren and colleagues (2000) suggested that causation of agents exposure in the working environment to airborne dusts related to occupational asthma and other respiratory symptoms.

Factors Associated with Occupational Respiratory Symptoms

Many studies shown that factors related to occupational respiratory symptoms were size of dust particles, level of hazardous exposure, and duration of hazardous exposure. They will be described as follow.

Size of dust particles

According to Chaikittiporn (1979), respirable dust was particles size less than 7 micron. Noppamas Hrimthepatip (B.E. 2542) also revealed that particulate matter less than 10 micron in blasting, crushing and grinding activity area in Saraburi province related to pulmonary function deterioration of people who live in there. Nuntawit Boondesh (B.E.2535) also found that sixty percent of respirable dust in Bangkok was 0.6-1.0 and 5-7 micron which related to declining of pulmonary function.

Level of hazardous exposure

There was association between dust concentration and byssinosis among textile workers (Cuwichian Borribunetrup, B.E.2537; and Lu, et al., 1987). Ong and colleagues (1987) also found that total dust concentration associated with byssinosis in Hong Kong textile workers. There was high prevalence of byssinosis in carding room workers (5.6%).

According to Chaikittiporn (1979), high total dust level had positively related to developed byssinosis among textile workers. He recommended that high dust exposure was the level which had respirable dust concentration greater than 1 mg/m^3 and total dust concentration greater than 2.5 mg/m^3. The low dust exposure was the level which had respirable dust concentration equal or less than 1 mg/m^3 and total dust concentration equal or less than 2.5 mg/m^3. Nuntawit Boondesh (B.E.2535) also found that accumulated respirable dust concentration was associated with declining of pulmonary function among traffic policemen in Bangkok metropolis (National Institute of Occupational Safety and Health recommended standard was 5 mg/m^3).

Moreover, Pornpan Watcharavitoon (B.E. 2542) stated that factors associated with reduced lung function were total dust concentration. Noppamas Hrimthepatip (B.E.2542) also revealed that there was a positive association between PM-10 concentration and pulmonary function deterioration of people who live in blasting, crushing and grinding activity area in Saraburi province.

However, Cuwichian Borribunetrup (B.E.2537) recommended that there was not significant association between total dust concentration and byssinosis/mill fever.

Duration of hazardous exposure

Li and colleagues (1987) found that there was significant association between duration of cotton dust exposure and byssinosis. Massin and colleague(1991) also found that Monday tightness' prevalence (specific manifestation of byssinosis syndrome) was increased in textile workers who exposure cotton dust at least 20 years in France.

Moreover, Noppamas Hrimthepatip (B.E.2542) found that there was positive association between duration of PM-10 exposure and pulmonary function deterioration of people who live in blasting, crushing and grinding activity area in Saraburi province. Srichant Uthayopas (B.E. 2536) also shown that duration of work correlated with lung function loss among workers who exposed particulate in friction product plants. Nuntawit Boondesh (B.E.2535) also revealed that duration of working (length of employment) was associated with declining of pulmonary function among traffic policemen in Bangkok metropolis. Lee and colleagues (1997) also postulated that number of years in the industry associated with the presence of pulmonary and upper respiratory tract mucous membrane symptoms among newspaper pressroom workers.

On the other hand, Cuwichian Borribunetrup (B.E.2537) revealed that duration of employment was not related to byssinosis liked-syndrome among textile workers. Pornpan Watcharavitoon (B.E. 2542) also stated that there was not relationship between duration of working and respiratory symptoms among animal-feed workers.

These risk factors (size of dust particle, level of hazardous exposure, and duration of hazardous exposure) provoked to occupational respiratory symptoms. In home-based cloth manufacturing, these factors likely caused respiratory symptoms that associated with occupational respiratory diseases.

Dust Particles, Measurement of Particulate Exposure, and Air Quality

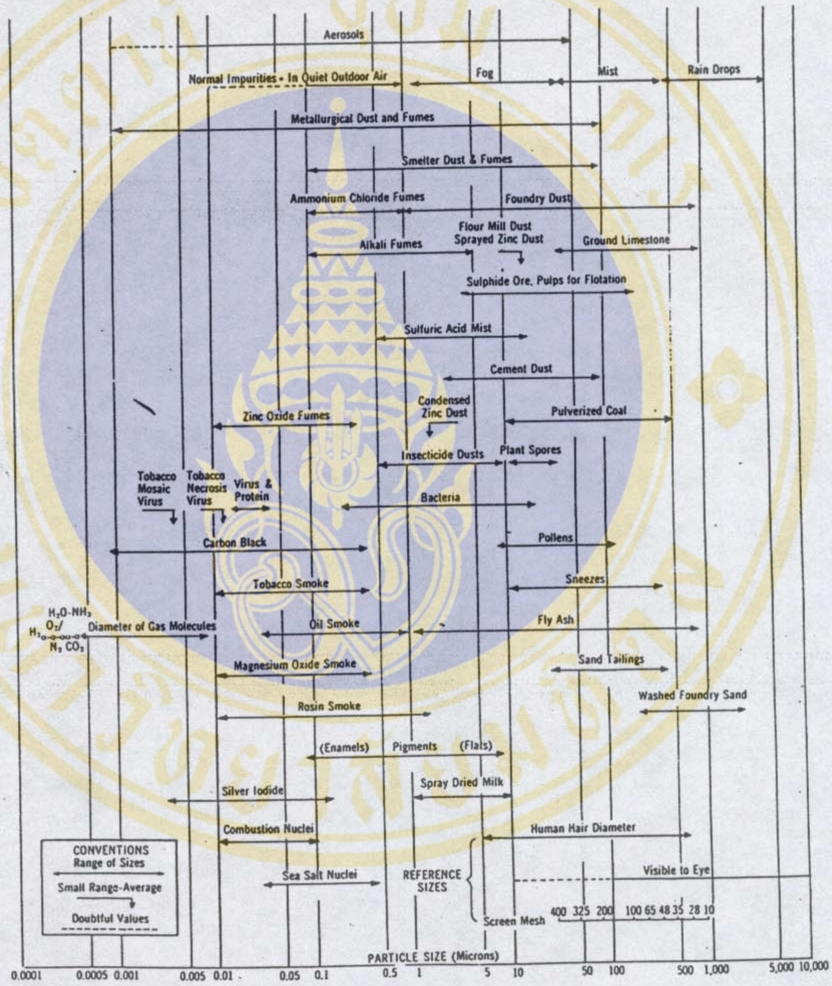
Cloth Sample Analysis

Mr. Natee Srisawat- who is the Lecturer of Department of Chemical Textile Engineering of Faculty of Engineering Rajamangala Institute of Technology- analyzed three samples of cloth which were as input materials of home-based cloth work by cloth solvency method, which is the most convinced method (Veerasak Udomkijdecha, B.E.2542). The findings described that the sample I, which was always used to be input material of these process, made from *Cotton fibers*. The sample II and sample III, which were usually used to be initial materials were composed of *Rayon fibers* and *Polyester fibers*, respectively.

Cotton fiber is a cellulose fiber that is a vegetable product. The specific physical characteristics of this fiber are fragile and light fiber. It will be a source of dust generation when it is cut or broken. Rayon fiber is a cellulose inventive fiber that made from cellulose chemical synthesis**.** The physical characteristics of this fiber are similar to cotton fiber. Polyester fiber is a chemical synthetic fiber, which is stronger stretch than cotton fiber and rayon fiber.

Dust Particles

Physical characteristics of dust particles, dusts are particulates produced by shattering, abrasion, and cutting (Chanlett, 1979: 217-218). The industrial hygienist measures the size of airborne dust particles in microns (μm), a unit that is one thousandth of a millimeter or approximately one twenty-five thousandth of an inch (Chanlett, 1979: 217; and Hogan, 1993:178). All concentrations are in weight per cubic meter. Size and density of dust determine settling behavior in the inhalation risk. These patterns are described that density of particles over 5,000 micron settles in accord with gravity acceleration. These have no physiological significance as they drop from the respirable zone immediately. Particle sizes down to 100 micron can not see by unaided eye. The microscopic range is from 0.2 to 10 micron. Flourmill dusts size range narrowly around 10 micron, the dynamic behavior of fine particulate sized below 10 micron shown the very slow removal by gravity. These are the sizes that enter the respiratory tract. Stirred setting time is the period required for one-half of the particles of the stated size and specific gravity to drop from a 2-m (7-ft) level after dust generation stops. The respirable size under 1micron remains suspended for 8 to 16 hours. Stopping distance is a measure of the throw that the kinetic energy of generation. For particles under 10 μm, it is less than 2.5 cm. (1 in). For particles of 1 micron and less, the throw is 0.25 mm. (0.01 in). The small size particles are not being hurtled away from the worker at a dust-generating operation to the extent that his breathing zone is clear of respirable sizes. The respirable size is staying right with the workers, lingering in their breathing zone. The actual size of airborne particles is illustrated in Figure 5.



(Hogen, 1993: 178)

Figure 5 The actual size of airborne particles

Fate of Particles in the Respiratory System

Brown (1960) summarized that the phenomena of penetration and retention of particulates is a function of equivalent aerodynamic size. The physiological effects are depend on the chemical actions between the inhaled material and the body. The conclusion is as:

1. Particles over 10 micron are captured in the nasal chambers by impaction. Mouth breathers lose part of the protection. Rapid, heavy breathing enhances it. The beneficial removal continues down to 5 micron, but it decreases. Mucus discharges remove them from the respiratory tract.

2. Particles from 5 to 2 micron settle in the middle respiratory passages, the trachea and bronchia, as the increasing cross-section area produces diminished velocities. Unimpaired ciliary action removes them.

3. Particles making the passage to the lungs are totally removed in the lung air spaces down to 2 micron sizes. This is not beneficial as the particles are trapped in the lungs. Defensive mechanisms of the lung tissue cannot cope with some dusts.

4. In the lung air spaces, the removal and retention decreases for particle sizes from 2 to 0.5 micron. These intermediate sizes remain suspended and are carried out on the tidal movement of breathing.

5. For particles below 0.5 micron, the pattern reverses. As the size of Brownian movement is reached, retention increases. The forces of diffusion precipitation drive the particle to the lung surfaces, where the body's defenses must meet the invasion.

6. For sizes from 1 to 2 microns, the percentage of particles which penetrate to the lung air spaces and which are retained there is at a maximum (Chanlett, 1979: 218-219).

Measurement of Particulate Exposure

The purpose of the measurement is to determine the validity of the hazardous exposure and the composition of the dust that remains suspended in air that workers breathe. An air sample which produces useful, revealing, and reliable information requires that it be taken for the hazardous substance at the point of exposure and for a time to make it representative of the inhaled air and its contaminant (Chanlett, 1979: 221-223; Hosey, 1973: 95-100; Jensen & O'Brien, 1993:537-548; and Lehtimaki & Willeke, 1993: 112-120). In air sampling the identity of the toxicant and any possible interfering substances must be know, and the cycle of operation or process must be observed.

The point of sampling bounds the interpretation of results in terms of the quantity of contaminants inhaled. Breathing-level samplers taken at the workers' position, and following their movements for the time it take to complete a typical job, closely approximates their inhalation concentration. However, the particle size distribution measured may be very different if the techniques are based on measurements of different particle properties (Hogan, 1993: 190-192). The result of air sampling such as information regarding particle size, number, and mass concentration; and the reliability of their interpretation are no better than the calibration of the instruments used and the abilities of the analyst handing a collection type of sample. There must be periodic calibration of instruments for the rate of airflow and for response to know concentrations. As a minimum the analyst must be given an information on any suspected interference. When the standard technique is used to evaluate dust concentration, particle larger than 10 micron are not considered because particle this size or larger do not remain suspended still air for appreciable lengths of time, nor do not penetrate deeply into the lung if they are inhaled. Larger particles seldom reach the lungs because they are filtered out in the nose and throat (Jensen & O'Brien, 1993:538-539).

A sample of the ambient air in the workroom, taken without reference to a particular process, position, or time in a cycle, represents the exposure for all the workers in that work area. It is useful to validate group complaints and to ensure that contaminants are under control.

A personal dust sampler as a size-selective device which is possible to collecting respirable sized particles (less than 5 micron) on the filter that depend on the following physical mechanisms for separating the particulates from the air. It has been developed that are suitable for work in indoor air or exposure studies (McFarland et al, 1987: 293-297; and Wiener & Rodes, 1993). Indoor particle measurements are made by using a sampling device in a fixed location or by using personal samplers carried by subjects in the environment of study. Personal environmental monitors are small, self-constrained, and battery-powered sampling systems that can be transported by the individual (Wiener & Rodes, 1993: 660). This illusion is shown in Figure 5

Standards of Air Quality

Standard of Notification of Office of the National Environment Board recommended that average value of suspended particulate matter (SPM) is as 0.33 mg/m^3 in 24 hours. The industrial Environment Division, Ministry of Industry set up the emission guideline for setting conditions after complaints that the maximum atmospheric particle concentration in workplace should not exceed the specific level as follow: average concentration during normal work period of nuisance dust (respirable and total dust) are 5 mg/m^3. (15 Mppcf) and 15 mg/m^3. (50 Mppcf), respectively (Mppcf is million particles per 1 cubic foot).

Dust Protective Actions

The occupational respiratory diseases can occur on acute or chronic respiratory symptoms after workers inhaled hazardous substance in their workplace. Purposes of occupational respiratory protective action was decreased harm exposure and remove potential hazards in the workplace by using protective equipment, environment sanitation, and other preventive methods which reduced dust exposure in workplaces are as follow:

1. Use of personal respiratory protective equipment such as respirator, simple filtration mask and protective clothing. The Occupational Safety and Health Administration (OSHA) has established a standard, 29 CFR 1910.134 Respiratory protection, for regulating the use of respiratory protective equipment. If the environment is still not completely safe after effective engineering and work practice controls have been fully used to reduce exposure to the lowest possible level, it will be necessary to use respirator to protect workers from contract airborne contaminants. According to Obase and colleagues (2000), dust respirators were effective in preventing occupational asthma attacks induced by buckwheat flour and wheat flour. Colton (1993) recommended that respiratory protective equipment varies in design, specifications, application, and protective capability. Proper selection depends on the contaminants involved, conditions of exposure, human capabilities, and respirator fit. The respiratory protectors are the least satisfactory means of exposure control because they provide good protection only if they are property selected, fit tested, worn by the employees, and replaced when their service life is over. This approach often has

substantial limitations including workers will often not wear such protection because it is cumbersome, causes other difficulties (Levy & Wegman, 1988:45-46), hot to wear, or it may reduce vision and interfere with communication (Colton, 1993: 619-620). Changes, cleaning, and repair the personal protective equipment such as gloves aprons and goggles must be provided to assure use and ensure protection. Facilities for hand washing, face washing, and body bathing and their use reduce dust inhalation, dermatitis, and ingestion from contaminated hands (Chanlett, 1979: 227-228).

2. Cleanly workplace is necessary for get ride of hazard contamination include machine, equipment, and workplace should be cleaned every time after or before being used because the contaminants will be cleaned up and causes reduced exposure. Good housekeeping may not be an exciting method, but it is an effective one, particularly for reducing dust concentrations. It reduced dust concentrations to acceptable levels in an overcrowded, rush-scheduled drop forge shop of a large aircraft factory during World War II (Chanlett, 1979: 227). The emphasis of cleaning method means wet method, dust-suppressant sweeping compounds, vacuum cleaning, immediate cleanup of spills, and the use of impervious surface and covet corners. Wet methods to reduce dust release are effective.

3. The separation of operation area reduces the number exposed and limits the area of control. According to the principle of health, eating and drinking should carry out the exposure area of the factory where they worked with toxic substance, and they should wash their hands before eating and clean their body after work. Their residence should separate out the factory area. In workplace should have the good ventilation of the system to eliminate odor dust, particles to remain at safety level. The factory should always clean and tidy without any refuse and should be receptacle to receiving or eliminating refuse according to suitability (Pairoj-Boriboon, 1989: 84).

4. Ventilation management is method of the most important engineering control techniques for improving or maintaining the quality of air in the occupational work environment such as removing a contaminant, diluting the concentration of a contaminant in workplace, and controlling of atmospheric contamination to healthful levels (Mutchler, 1973:573-574). The natural general ventilation can be ventilated by wind and thermal convection. These effects, usually in combination, result from natural pressure differences and air density difference respectively, causing natural

displacement and infiltration of air through windows, doors, walls, floors and other openings. Obviously, if it were sufficient, natural ventilation would be much cheaper than mechanical ventilation, but wind current are erratic and sometime hard to predict. According to Cheanbumrung (1982), recommended that dust concentration was decreased by ventilation manipulated. There was significantly correlated between decreased of cotton dust allergies and ventilation manipulated among cotton mill workers. Additionally, the resulting reduction of the infiltration rate of air from outdoors to indoors has decreased the potential for diluting indoor pollutants (Wiener & Rodes, 1993: 660).

5. Reducing duration of hazardous exposure period as a method of reducing hazardous inhalation. Fox and colleagues (1973) revealed that there was a positive relationship between working duration and respiratory symptoms among textile workers in Lancashire. Working duration was a significant predictor for estimated pulmonary function test. Surasiengsunk (1982) also shown that high exposure of respirable dust and working duration had highest correlated with diminishing of all pulmonary function among 604 cotton textile workers. Moreover, Moscato and colleagues (1999: Abstract) also found that cessation of exposure to the offending agent resulted in a decrease in asthma severity among the occupational asthma. Similarly, Toren and colleagues (2000) proposed that prevention of occupational asthma were moving the patients out of those workplaces.

6. Avoiding cigarette smoking is a factor reducing occupational respiratory disease because irritant of cigarette smoking can inhibit cilia's movement in airways (Cherniack et al., 1988:641-643). Fox and colleagues (1973) revealed that there was a relationship between cotton dust level and respiratory symptoms among textile workers in Lancashire. On one hand, Raza and colleagues (1999) reported smoking related respiratory symptoms of persistent cough, chronic production of phlegm, chest tightness, wheezing, and breathlessness among operative workers in Lancashire textile weavers.

7. Measurement hazards for early detection of respiratory disease may lead to control and prevent hazardous exposure to workers before workers become sick. The results of measurement can screen groups of workers who are high or low risk for appropriate use of respirators or other personal protective equipment. Toren and

colleagues (2000) shown that prevention of occupational asthma were controlling the reduced hazardous exposure at the workplace.

8. Education and advice concerning specific work hazards is essential (Levy & Wegman,1988: 45-52; and Pairoj-Boriboon, 1989:83-87). Workers should always be given full information about their workplace hazards and means of reducing their risk for health preventive behavior. Levy and Wegman (1988) found that the workers who were not aware of job hazard would not take the health and safety precautions necessary for protecting themselves and their coworkers. The health professional should advise the worker concerning the nature and prognosis of the worker's condition and the possible necessity for removing hazards and for personal protective equipment at work.

In addition, Notification of the Ministry of Industry of Thailand No. 4 B.E. 2514 indicated factory acting during toxic substance regulations. These method protection and protective equipment to prevent harm to the workers must conform to the following requirements including sufficient ventilation system in the operative room in connection with toxic substance, wearing protective equipment which as suitable for such work site, training /advising workers to understand the cause of harm which could occur during working, explaining the method of prevention, measuring harmful condition which could occur when they worked, and life span (Pairoj-Boriboon, 1989: 80-83).

Home-Based Cloth Work Process

In this study, cloth dusts are by-products of cloth work processes in three stages that are as follow:

Stage I: preparing input material, rolls of cloth were cut following the requirement patterns of product. This stage, cloth dusts occurred from cutting cloth fibers and arranging pieces of cloth for the next stage.

Stage II: producing process, pieces of cloth were saw by the sawing machine in home-based cloth work. Cloth dust particles come from cloth edge when moving pieces of cloth, so cloth fibers are frayed into airborne. In cloth woven-carpet working, there are many more cloth dust particles frayed into the air when stripes of cloth were woven.

Stage III: output product, outcome of the cloth work process were contaminated by cotton thread and cloth dusts. The workers must check and clean out their end product by brushing and waving. Dust particles from end stage remain in workplace's airborne.

In summary, home-based cloth workplaces are places where cloth products were made in dwellings. The end products of cloth work process are many small pieces of cloth that leave an amount of dust in indoor air. Latency hazardous exposures affect to health of workers and their household members. Research on home-based cloth worker's respiratory hazard exposure is not existed while a number of studies found that inhalation of cloth dust can decrease pulmonary function or provoke respiratory symptoms. The home-based workers should perceive their occupational harm, and determine to take health protective action for maintaining their health, and work efficacy. Therefore, this study hypothesizes that home-based cloth workers in Ayutthaya province might be at risk for respiratory symptoms, and these symptoms might be associated with level of dust particle exposure, duration of daily work hours, and total duration of cloth work and might be protected by dust protective actions such as using respiratory protective devices, cleansing workplace and devices after work, separation of working area, workplace ventilation, reducing diffusion of dust particle, and cleansing body after work.

CHAPTER III
MATERIALS AND METHODS

This was a cross-sectional study conducted to explore associations between home-based cloth work and respiratory symptoms among home-based cloth workers in Bansang subdistrict Ayutthaya province. The purposes of this study were (1) to measure to total dust concentration exposure among home-based cloth workers; (2) to measure to size of dust particles that home-based cloth workers exposed; (3) to examine an association between home-based work and respiratory symptoms; (4) to examine associations between risk factors and respiratory symptoms among home-based cloth workers; (5) to examine associations between dust protective actions and respiratory symptoms among home-based cloth workers. Materials and methods used in this study were as follow:

Setting of the Study

This study was conducted in Bansang subdistrict of Bangpa-in district, Ayutthaya province which was a sub-urban area. Bansang Community had an estimated population of 3,609. There were approximately 859 households. Of these, there was about 180 home-based cloth workplaces. Their regular working hour was from 8 a.m. to 6 p.m. Since cloth products were made in home-based workplaces, cloth workers were often expose to small dust particles diffusing from cloth.

Population and Samples

The population of this study was all home-based cloth workers in Bansang subdistrict Bangpa- in district Ayutthaya province. They were classified into an exposure group. Using a one to one ratio, the same number of non home-based cloth workers were recruited into a non-exposure group. A sample consisted of 129 home-based cloth workers (exposure group) and 129 non-home-based cloth workers (non-exposure group). Additionally, two subjects of non-home-based cloth workers and 9 home-based cloth workers from 9 different workplaces were selected for cloth dust exposure measurement of total dust concentration and size.

Sampling

The exposure group included all home-based cloth workers who had been working in home-based cloth workplace in Bansang subdistrict for at least 6 months to the date of data collection, and willing to participate in this study. While non-exposure group was randomly recruited from persons aged over 15 years who lived in Bansang subdistrict, but worked in non home-based cloth workplace. A name list of all non home-based cloth workers in Bansang subdistrict in July 2002 were used to draw subjects into a non-exposure group by using random sampling technique without replacement. In each village, they were recruited in equivalent number to the exposure group. For example, there were 25 home-based cloth workers in village I, 25 non home-based cloth workers were also be recruited into a non-exposure group.

Samples of cloth dust measurement

Ten samples of cloth dust from different types of home-based cloth workplace were selected for measurement of total dust concentration and size. Stratified random sampling was used. Types of home-based cloth workplace were classified as shown in Figure 6. Two samples were drawn from each type: one in well ventilated environment (G) and the other in poorly ventilated environment (P) as illustrated in Figure 6.

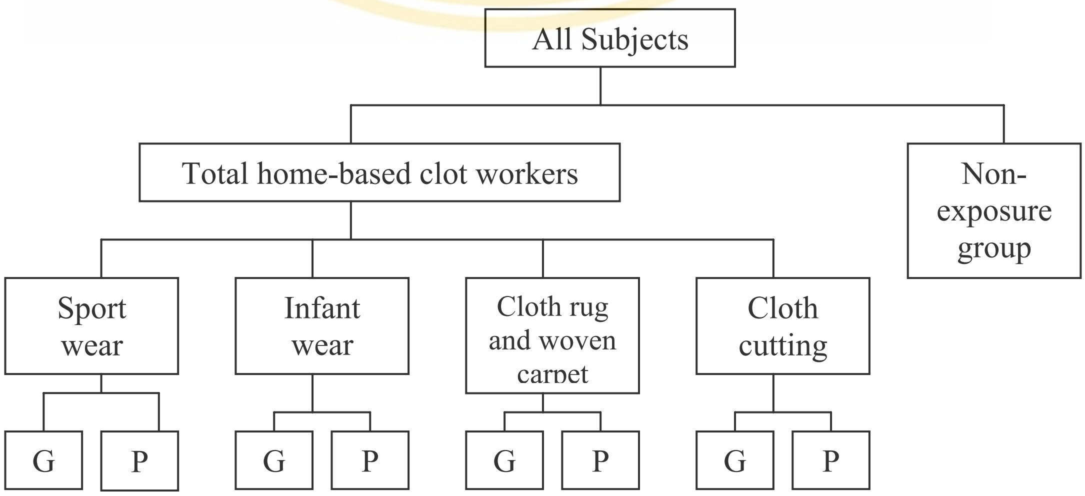


Figure 6. Sampling of total dust measurement samples

Poorly ventilated workplace environment refers to the home-based cloth workplace in a closed room or air-condition room without a ventilator. Well-ventilated workplace environment was the home-based cloth workplace, which had channel of natural air flow that could ventilate by wind and thermal convection (Mutchler, 1973: 573-574), or an open-air space.

Measurement

Instruments used in this study composed of (1) an interview form and (2) personal dust samplers. They were as follow:

1. An Interview Form

An interview form includes 4 parts: background characteristics; risk factors; dust protective actions; and respiratory symptoms.

Part I: Background characteristic data form

The first part of the interview form composed of background characteristics including: sex, age, years of education, monthly income, past respiratory illness, cigarette smoking history, and occupation. (See Appendix B)

Part II: Risk factors checklist

The second part of the interview form composed of risk factors including: level of total dust concentration exposure, duration of daily working hours, and total duration of cloth work. There were 3 items with regard to these risk factors in the interview form. Answers of these questions were classified into two groups that are high risk and low risk based on the literature reviewed. For level of total dust concentration exposure, equal 5 mg/m^3 or less was low risk and higher was high risk. For duration of daily working hours, working longer than 8 hours is high risk. For total duration of cloth work, workings in home-based cloth workplace longer than 6 years was high risk. (See Appendix B)

Part III: Dust protective action data form

The third part of this interview form composed of 6 questions about dust protective actions including: using respiratory protective devices, cleansing workplace and devices after work, separation of working area, workplace ventilation, reducing diffusion of dust particles, and cleansing body after work. The investigator developed this checklist based on the literature review. It composed of 6 items. The respondents were asked to choose the answer of always taking, sometimes and non-taking each dust protective action. For those taking any of dust protective actions, the investigator asked them to describe what and how the action(s) was carried out. (See Appendix B)

Part IV: Respiratory symptoms form

The last part is a checklist with regard to respiratory symptoms. The investigator developed it based on literature review . There are 5 items including: cough, phlegm production, chest tightness, nasal congestion, and wheezing. The respondents were asked to choose the answer of presence and absence of each respiratory symptom. (See Appendix B)

2. Personal Dust Samplers

Personal dust samplers were used to collect total dust in breathing zone of 9 home-based cloth workers and 2 non home-based cloth workers. The results of these measurements were total dust concentration measurement and particle sizes, which were used to classify type of work into low and high level of total dust concentration exposure.

Method of dust sampler was TSP (Total Suspended Particle). The personal dust samplers were used to collect total dust in home-based cloth workplaces were GILIAN® which were Gil Air-5 model. Dust was collected and analyzed by industrial hygienist of Department of Environmental Science, Faculty of Science, Silpakorn University Nakorn Pathom. (See Appendix C)

Method of total dust collection

1. Prepare devices of dust collected including: personal dust sampler, Cassette holder, and filtered paper (Whatman No 41 cellulose)

2. Put "Whatman No.41 cellulose" which suit the cassette.

3. Connect personal dust sampler and cassette before put it on the sample.

4. Set the dust sampler on lumbar area of sample and set the cassette on collar (near breathing zone of sample). (See Figure. 7)

5. Start collecting dust particles during the sample works and stop collecting when he/she finishes his/her daily cloth working. Total time of collecting is

equal duration of daily cloth working. In this study, time duration was represented to 1 hour.

6. Record the time of dust collection.

7. Keep the dust sample (filtered paper) in the box carefully after finishing dust collection.

8. Analyze the total dust collected sample.

(Lehtimaki & Willeke, 1993: 661)

Figture 7. A personal dust sampler

Results of total dust measurement

The results of total dust measurement were shown as total dust concentration (mg/m^3), amount of dust particles (particles per cubic feet) and sizes of dust particles (micron)

Calibration

Personal dust samplers were calibrated before used by GILIAN Gilibrator 2 VER 4.0. (Appendix E)

Data Collection

Procedure of Data Collection

After obtaining permission from the Faculty of Graduate Studies, Mahidol University and the Head of Bangpa-in Health Care Office, Ayutthaya province, a schedule of data collection at Bansang community was established: Monday through Saturday from 9 a.m. to 3 p.m. Interviewed data were collected during home-based cloth workers' breaking time. Ten samples of cloth dust from different workplaces, which make different products and have different workplace environments, were collected and measured total dust concentration and size. About 30 workers were interviewed each day, and all total dust measurements were collected within the first 5 days. The investigator was introduced to the Head of Bansang Health Care Center and health volunteers of this area. The investigator informed respondents that this study was to describe their background characteristics, their risk factors, dust protective actions, and respiratory symptoms. Confidentiality was addressed. Data were collected anonymously. Verbal informed consent was individually given to all respondents prior to data collection. In addition to being given descriptive of the study, respondents were assured that their participation or non-participation would not have effects on their health care service received. Total time spent in giving instruction, interviewing, and filling out the questionnaire was about 15 minutes. All respondents were thanked for their participation at the end of the interview. Data forms were edited for completion by the investigator before ending data collection in this area.

Data Analysis

All data were analyzed by using SPSS for window program and Epi Info version 6.

1.Descriptive statistics: Data on background characteristics (sex, age, years of education, monthly income, past respiratory illness, cigarette smoking history, and type of occupation); risk factors (level of total dust concentration exposure, duration of daily working hours, and total duration of cloth work); dust protective actions (using respiratory protective devices, cleansing workplace and devices after work, separation of working area, workplace ventilation, decreasing diffusion of dust particles, and cleansing body after work); and respiratory symptoms [cough, phlegm production, chest tightness, nasal congestion, wheezing, and respiratory symptom(s)] were analyzed by using descriptive statistics: frequency, percentage, mean and standard deviation, as appropriate.

2. Inferential statistics: Background characteristic data of exposure group and non-exposure group were compared by Chi-square test or t-test, as appropriate. Associations between home-based cloth work and respiratory symptoms, risk factors and respiratory symptoms, and dust protective actions and respiratory symptoms were examined using Odds ratio with 95% confidence interval.

CHAPTER IV
RESULTS

Research findings include subjects' background characteristics, total dust concentration measurement, risk factors, dust protective actions, and associations between these variables and respiratory symptoms. They were presented as follows:

Subjects' Background Characteristics

The result of descriptive data analysis shown that the majority of the subjects were female (80.6%). The average of age was 37 years old (S.D.= 10.77) with a range between 16 and 59 years old. The average of years of education was 6 years (S.D.= 4.0). The majority of the subjects had 4 years of education or Phathomsucksa 4 (43.8%). The average of monthly income was 4243.37 bath (S.D.= 2991.38). The majority had monthly income 4,000 bath (24.9%). About 91.5% of the subjects did not have respiratory illness in the past year. The majority of all subjects were non-smoker (86.4%), whereas 10.1% used to smoke. Only 3.5% of the subjects were recent smoker. About a half of the subjects were home-based cloth workers. Other occupations were merchant, employee, government civil, agriculture and miscellaneous (17.4%, 12.8%, 7.4%, 1.9% and 10.5%, respectively), as shown in Table 1.

Table 1 Background Characteristics Data (N =258)

Data	**n (%)**
Sex	
Male	50 (19.4)
Female	208 (80.6)

Table 1 Background Characteristics Data (N =258) (Cont.)

Data	**n (%)**
Age (years)	
	(Mean = 37.45 S.D. = 10.77 Min = 16 Max = 59)
Years of education	
	(Mean = 6.5 S.D. = 4.0 Min = 0 Max = 16)
Monthly income	
	(Mean = 4243.37 S.D. = 2991.38 Min = 0 Max = 20,000)
Past respiratory illness	
Yes	22 (8.5)
No	236 (91.5)
Cigarette smoking history	
Non-smoker	223 (86.4)
Recent smoker	9 (3.5)
Smoker	26 (10.1)
Occupation	
Home-based cloth worker	129 (50.0)
Government civil	19 (7.4)
Agriculture	5 (1.9)
Merchant	45 (17.4)
Employee	33 (12.8)
Miscellaneous	27 (10.5)

Comparisons of Background Characteristics between Exposure and Non-Exposure Groups

There were statistically significant differences between exposure and non-exposure groups in age and years of education. The average age of the exposure group was older than the non-exposure group (t-value = 2.529, $p < .05$). The average of years of education of the non-exposure group was higher than the exposure group (t-value = 7.135, $p < .001$). However, there was no significantly differences in sex, monthly income, past respiratory illness and cigarette smoking history ($p > .05$). In both groups, there were more female than male. The majority of both exposure (88.4%) and non-exposure groups (94.6%) did not have respiratory illness that related to respiratory symptoms in this study in the past year. About 86% of exposure group and 86.8% of non-exposure group were non-smokers, as presented in table 2.

Table 2 Comparisons of Background Characteristic between Exposure and Non-exposure Groups Data (N=258)

Background characteristics	Home-based cloth work n (%)		χ^2 or t-value	p-value
	Yes	No		
Sex [a]				
Male	20 (15.5)	30 (23.3)	χ^2 = 2.481	.115
Female	109 (84.5)	99 (76.7)		
Age (years) [b]				
Mean	39.13	35.78	t = 2.529	.012*
S.D.	10.31	11.00		
Years of education [b]				
Mean	4.88	8.12	t = 7.135	.000**
S.D.	2.56	4.49		
Monthly income [b]				
Mean	4800.79	4281.86	t = 0.741	.459
S.D.	3214.96	7218.66		
Past respiratory illness [a]				
Yes	15 (11.6)	7 (5.4)	χ^2 = 3.180	.075
No	114 (88.4)	122 (94.6)		
Cigarette smoking history [a]				
Non-smoker	111 (86.0)	112 (86.8)	χ^2 = 0.116	.944
Recent smoker	5 (3.9)	4 (3.1)		
Smoker	13 (10.1)	13 (10.1)		

a = categorical variable gives n (%), χ^2-value and p-value.

b = continuous variable gives n (%), t-value and p-value.

*** = significant p< .05 ** = significant p< .001**

Reports of Dust Measurement

Dust particles in subjects' workplace were measured by TSP method (Total Suspended Particle). The personal dust samplers were used to collected total dust in this study was GILIAN ® which was Gil Air-5 model (in Appendix E). Large amounts of dust were collected and analyzed. The results were as illustrated in Table 3.

The highest total dust particles were found in infant wear work area with poor ventilation, infant wear work with good ventilation, and cloth rug/ woven carpet work area with good ventilation (158,020 particles per cubic foot, 121,316 particles per cubic foot and 114,109 particles per cubic foot, respectively). The standard of amount of dust particle in workplace of Thai Safety Law are not exceed 15 (respirable dust) and 50 (total dust) million particles per cubic foot (Mppcf).

The total dust concentration of every measurement workplaces in this study was lower than the standard level of National Institute for Occupational Safety and Health (15 mg/ m^3)(NIOSH, 1977). There was highest total dust concentration in this study was reported in cloth cutting work area with poor ventilation (12.08 mg/ m^3), and there was the lowest total dust concentration in office that were non-exposure group (2.08 and 3.33 mg/ m^3).

All of dust measured subjects were classified into high and low level of total dust concentration exposure. The workplace which had total dust concentration over 5 mg/ m^3 was high level of total dust concentration exposure area, and workplace the lower or equal 5 mg/ m^3 was low level of total dust concentration exposure area. This study, the low level of total dust concentration exposure workplaces were sport wear work area with good ventilation, cloth rug/woven carpet work area with good ventilation, infant wear work area with good and poor ventilation, cloth cutting work area with good ventilation and the non-exposure group workplaces. The high level of total dust concentration exposure workplaces were sport wear work area with poor ventilation, cloth rug/woven carpet work area with poor ventilation, and cloth cutting work area with poor ventilation. Number of dust particles did not relate to total dust concentration values. (See Appendix C)

Table 3 Reports of Total Dust Measurement (N=11)

Type of home-based cloth manufacturing	Dust particle (particles/cubic feet) Size of particle (micron) 0.81	1.15	1.63	2.30	3.25	4.60	6.50	9.20	13.01	>13.01	Total dust (particle / Cubic feet)	Total dust (particles / m^3)	Total dust concen-tration (mg/ m^3)	Total respiable dust (particle / Cubic feet)
Sport wear [a]	6,770	5,177	7,566	1,195	7,168	4,381	2,389	3,186	2,389	7,566	47,787	1,353	4.17	31,062
Sport wear [b]	29,002	10,986	6,591	11,425	11,865	1,318	3,076	3,076	2,197	879	80,415	2,277	4.17	48,337
Sport wear [b]	57,622	14,959	6,094	3,324	2,216	4,986	5,540	2,216	3,324	554	100,835	2,856	7.08*	39,335
Cloth rug/woven [a]	44,602	21,432	6,951	5,792	10,426	10,426	7,530	5,792	1,158	-	114,109	3,232	3.33	68,349
Cloth rug/woven [b]	5,038	4,149	3,260	5,334	6,520	5,631	2,964	2,964	2,371	1,482	39,713	1,125	10.00*	30,822
Infant wear [a]	116, 390	16,142	10,195	4,248	9,345	850	-	-	850	-	158,020	4,475	2.50	40,780
Infant wear [b]	47,915	37,211	12,743	7,136	4,078	3,568	3,058	2,549	2,039	1,019	121,316	3,436	3.75	70,343
Cloth cutting [a]	23,749	29,542	9,268	9,268	6,372	4,055	3,475	3,475	2,317	579	92,100	2,608	5.00	65,455
Cloth cutting [b]	22,387	3,789	2,411	5,166	7,233	4,477	3,100	3,789	689	1,722	54,763	1,551	12.08*	29,965
Government civil	3,641	728	8,738	4,005	2,185	5,461	3,277	2,549	1,456	2,913	34,953	990	3.33	26,943
Officer	1,820	9,102	6,190	1,820	2,185	5,826	5,461	1,820	1,092	5,097	40,413	1,145	2.08	32,404

Standard of total dust concentration of OHSA is 15 mg/ m^3
a = Good ventilation workplace b = Poor ventilation workplace
*** = High level of total dust concentration exposure**

Associations between Respiratory Symptoms and Home-Base Cloth Work

Odds ratio of associations between respiratory symptoms and home-based cloth work were shown in Table 4. There were statistical significant associations between home-based cloth work and all respiratory symptoms. The results demonstrated that home-based cloth workers were 3.46 times more likely to report coughing a wakening than non- home-based cloth workers (95% CI = 1.40-8.77). Home-based cloth workers were 4.26 times more likely to report bringing up phlegm a wakening than non home-based cloth workers (95% CI = 1.90-9.75). Home-based cloth workers were 6.98 times more likely to report chest tightness during work than those who did not involve home-based cloth workers (95% CI = 3.08-16.24). Those with home-based cloth work were 3.84 times more likely to have nasal congestion or catarrh during or after work than those who did not involve home-based cloth work (95% CI = 2.15-6.89). Home-based cloth workers were 4.61 times more likely to have wheezing sound than those who were non home-based cloth workers (95% CI = 1.82-12.18). Home-based cloth workers were 3.75 times more likely to have at least one of those respiratory symptoms than non home-based cloth workers (95% CI = 2.17-6.51).

Table 4 Association between Respiratory Symptoms and Home-Based Cloth Work (N= 258)

Respiratory symptoms	Home-based cloth work n (%)		OR (95%CI)
	Yes	No	
Cough			
Yes	24 (18.6)	8 (6.2)	3.46(1.40-8.77)*
No	105 (81.4)	121 (93.8)	
Phlegm production			
Yes	34 (26.4)	10 (7.8)	4.26(1.90-9.75)*
No	95 (73.6)	119 (92.2)	
Chest tightness			
Yes	43 (33.3)	9 (7.0)	6.98(3.08-16.24)*
No	86 (66.7)	120 (93.0)	
Nasal congestion			
Yes	65 (50.4)	27 (20.9)	3.84(2.15-6.89)*
No	64 (49.6)	102 (79.1)	
Wheezing			
Yes	27 (20.9)	7 (5.4)	4.61(1.82-12.18)*
No	102 (79.1)	122 (94.6)	
Respiratory symptom(s)			
Yes	89 (69.0)	48 (37.2)	3.75(2.17-6.51)*
No	40 (31.0)	81 (62.8)	

*** = Significant**

Home-Based Cloth Workers' Respiratory Symptoms, Risk Factors, and Dust Protective Actions

Table 5 shown frequency and percentage of home-based cloth workers' risk factors, and dust protective actions. About 31.8%, 10.1%, 4.7% and 3.5% of home-based cloth workers produced sport wear, infant wear, cloth rug /woven carpet and cloth cutting, respectively. Half of home-based cloth workers had low level of total dust concentration exposure (55.9%). The majority of home-based cloth workers had working time on home-based cloth work over 8 hours a day (60.5%). About 72.1% of home-based cloth workers had cloth work time over 6 years.

In this study, dust protective actions were using respiratory protective devices, cleansing workplace and devices after work, separation of working area, workplace ventilation, reducing diffusion of dust particles, and cleansing body after work. Data analysis has shown that only 7% of home-based cloth workers used respiratory protective devices (always used = 2.3% and sometimes = 4.7%). The reported respiratory protective devices were simple cloth masks. There were 86% of home-based cloth workers cleaned their workplace and devices after work (everyday = 65.9% and sometimes = 20.2%). The reported workplace and devices cleansing method were such as dry sweeping by mop. The majority of home-based cloth workers separated their working area from living area (85.3%). Home-based cloth workers worked in well ventilated workplace was 60.5%. More than a half of home-based cloth workers reduced diffusion of dust particles in their workplace (always reduced 38.8% and sometimes 14.7%). The investigator observation found that they did not turn on an electric fan into their working area. About 58.9% of home-based cloth workers cleaned their body and changed dressing after work (always cleaned 26.4% and sometimes 32.5%).

Table 5 Types of Home-Based Cloth Work and Home-Based Cloth Workers' Risk Factors, and Dust Protective Actions (N=129)

Variables	n (%)
Types of home-based cloth work	
Sport wear	82 (31.8)
Infant wear	26 (10.1)
Cloth rug and woven carpet	12 (4.7)
Cloth cutting	9 (3.5)
Risk factors	
Level of total dust concentration exposure	
High level of total dust concentration exposure	57 (44.1)
Low level of total dust concentration exposure	72 (55.9)

Table 5 Type of Home-Based Cloth Work and Home-Based Cloth Workers' Risk Factors, and Dust Protective Actions (N=129) (Cont.)

Variables	n (%)
Duration of daily working hours	
Over 8 hours	78 (60.5)
Equal or less than 8 hours	51 (39.5)
Total duration of cloth work	
Over 6 years	93 (72.1)
Equal or less than 6 years	36 (27.9)
Dust Protective Action	
Using respiratory protective devices	
Always used	3 (2.3)
Sometimes	6 (4.7)
Never	120 (93.0)
Cleansing workplace and devices after work	
Everyday	85 (65.9)
Sometimes	26 (20.2)
Never	18 (14.0)
Separation of working area	
Yes	110 (85.3)
No	19 (14.7)
Workplace ventilation	
Good	78 (60.5)
Poor	51 (39.5)
Reducing diffusion of dust particles	
Always	50 (38.8)
Sometimes	19 (14.7)
Never	60 (46.5)
Cleansing body after work	
Always	34 (26.4)
Sometimes	42 (32.5)
Never	53 (41.1)

Respiratory symptoms included this study were cough, phlegm production, chest tightness, nasal congestion, wheezing and at least one of those respiratory symptoms as shown in Table 6. The majority of home-based cloth workers did not cough at wakening (81.4%). About 26.4% of home-based cloth workers brought up phlegm at wakening. There was 22.5% of home-based cloth workers had chest tightness during work, More than a half of home-based cloth workers had nasal congestion or catarrh during or after work (50.4%). About 20.9% of home-based cloth workers had wheezing sound. Sixty nine percent of home-based cloth workers had at least one of these respiratory symptoms.

Table 6 Home-Based Cloth Workers' Respiratory Symptoms (N=129)

Variables	n (%)
Respiratory symptoms	
Cough	
Yes	24 (18.6)
No	105 (81.4)
Phlegm production	
Yes	34 (26.4)
No	95 (73.6)
Chest tightness	
Yes	29 (22.5)
No	100 (77.5)
Nasal congestion	
Yes	65 (50.4)
No	64 (49.6)
Wheezing	
Yes	27 (20.9)
No	102 (79.1)
Respiratory symptom(s)	
Yes	89 (69.0)
No	40 (31.0)

Associations between Risk Factors and Cough

Table 7 shown frequency, percentage, Odds ratio and 95% confident interval of associations between risk factors and cough of home-based cloth workers. It was found that home-based cloth workers who exposed to high level of total dust concentration exposure were 3.12 times more likely to cough than those who exposed to low level of total dust concentration exposure (95% CI = 1.13-8.84), and there was a statistically significant association.

Home-based cloth workers who worked over 8 hours a day were 0.90 times less likely to cough than home-based cloth workers who worked equal or less than 8 hours a day (95% CI = 0.33-2.42). Home-based cloth workers who had total duration of cloth work over 6 years were 0.58 times less likely to cough than home-based cloth workers who had total duration of cloth work equal or less than 6 years (95% CI = 0.21-1.63). However, there was no statistically significant association between these risk factors and cough.

Prevalence rate of cough among home-based cloth workers with high level of total dust concentration exposure was higher than those with low level of total dust concentration exposure (28.0% VS 11.1%).

Table 7 Associations between Risk Factors and Cough among Home-Based Cloth Workers (N=129)

Risk factors	Cough n(%)		OR (95% CI)
	Yes	No	
Level of total dust concentration exposure			
High level of total dust concentration exposure	16(66.7)	41(39.0)	3.12(1.13-8.84)*
Low level of total dust concentration exposure	8(33.3)	64(61.0)	
Duration of daily working hours			
Over 8 hours	14(58.3)	64(61.0)	0.90(0.33-2.42)
Equal or less than 8 hours	10(41.7)	41(39.0)	
Total duration of cloth work			
Over 6 years	15(62.5)	78(74.3)	0.58(0.21-1.63)
Equal or less than 6 years	9(37.5)	27(25.7)	

*** = Significant**

Associations between Risk Factors and Phlegm Production

Table 8 shown frequency, percentage, Odds ratio and 95% confident interval of associations between risk factors and phlegm production of home-based cloth workers. It was revealed that home-based cloth workers who exposed to high level of total dust concentration exposure were 1.17 times more likely to bring up phlegm than those who exposed to low level of total dust concentration exposure (95% CI = 0.50-2.76). Home-based cloth workers who worked over 8 hours a day were 1.08 times more likely to bring up phlegm than home-based cloth workers who worked equal or less than 8 hours a day (95% CI = 0.45-2.60). Home-based cloth workers who had total duration of cloth work over 6 years were 1.10 times more likely to bring up phlegm than home-based cloth workers who had total duration of cloth work equal or less than 6 years (95% CI = 0.42-2.93). However, none of these associations was statistically significant between risk factors and phlegm production.

Prevalence rate of phlegm production among home-based cloth workers with high level of total dust concentration exposure and over 8 hours work were higher than those with low level of total dust concentration exposure and 8 hours or less work (28.1% VS 25.0% and 26.9% VS 25.5%).

Table 8 Associations between Risk Factors and Phlegm Production among Home-Based Cloth Workers (N=129)

Risk factors	**Phlegm production n (%)**		**OR (95% CI)**
	Yes	**No**	
Level of total dust concentration exposure			
High level of total dust concentration exposure	16(47.1)	41(43.2)	1.17(0.50-2.76)
Low level of total dust concentration exposure	18(52.9)	54(56.8)	
Duration of daily working hours			
Over 8 hours	21(61.8)	57(60.0)	1.08(0.45-2.60)
Equal or less than 8 hours	13(38.2)	38(40.0)	
Total duration of cloth work			
Over 6 years	15(73.5)	78(71.6)	1.10(0.42-2.93)
Equal or less than 6 years	9(26.5)	27(28.4)	

Associations between Risk Factors and Chest tightness

Table 9 shown frequency, percentage, Odds ratio and 95% confident interval of associations between risk factors and chest tightness of home-based cloth workers. This study found that home-based cloth workers who exposed to high level of total dust concentration exposure were 1.77 times more likely to have chest tightness during work than those who exposed to low level of total dust concentration exposure (95% CI = 0.71-4.42). Home-based cloth workers who worked over 8 hours a day were 0.91 times less likely to have chest tightness during work than home-based cloth workers who worked equal or less than 8 hours a day (95% CI = 0.36-2.28). Home-based cloth workers who had total duration of cloth work over 6 years were 1.02 times more likely to have chest tightness during work than home-based cloth workers who had total duration of cloth work equal or less than 6 years (95% CI = 0.37-2.85). However, there was no statistically significant association between risk factors and chest tightness during work, as illustrated in Table 9.

Prevalence rate of chest tightness among home-based cloth workers with high level of total dust concentration exposure and over 6 years work were higher than those with low level of total dust concentration exposure and 6 years or less work (28.1% VS 18.1% and 22.6% VS 22.2%).

Table 9 Associations between Risk Factors and Chest Tightness during Work among Home-Based Cloth Workers (N=129)

Risk factors	**Chest tightness n(%)**		**OR (95% CI)**
	Yes	**No**	
Level of total dust concentration exposure			
High level of total dust concentration exposure	16(55.2)	41(41.0)	1.77(0.71-4.42)
Low level of total dust concentration exposure	13(44.8)	59(59.0)	
Duration of daily working hours			
Over 8 hours	17(58.6)	61(61.0)	0.91(0.36-2.28)
Equal or less than 8 hours	12(41.4)	39(39.0)	
Total duration of cloth work			
Over 6 years	21(72.4)	72(72.0)	1.02(0.37-2.85)
Equal or less than 6 years	8(27.6)	28(28.0)	

Associations between Risk Factors and Nasal Congestion

Home-based cloth workers who exposed to high level of total dust concentration exposure were 1.72 times more likely to have nasal congestion or catarrh during or after work than those who exposed to low level of total dust concentration exposure (95% CI = 0.80-3.69). Home-based cloth workers who worked over 8 hours a day were 0.50 times less likely to have nasal congestion or catarrh during or after work than home-based cloth workers who had working time equal or less than 8 hours a day (95% CI = 0.23-1.09). Home-based cloth workers who had total duration of cloth work over 6 years were 1.19 times more likely to have nasal congestion or catarrh during or after work than home-based cloth workers who had total duration of cloth work equal or less than 6 years (95% CI = 0.52-2.76). However, these associations between risk factors and nasal congestion were not statistically significant, as presented in Table 10.

Prevalence rate of nasal congestion among home-based cloth workers with high level of total dust concentration exposure and over 6 years work were higher than those with low level of total dust concentration exposure and 6 years or less work (57.9% VS 44.4% and 51.6% VS 47.2%).

Table 10 Associations between Risk Factors and Nasal Congestion among Home-Based Cloth Workers (N=129)

Risk factors	Nasal congestion		OR (95% CI)
	Yes	No	
Level of total dust concentration exposure			
High level of total dust concentration exposure	33(50.8)	24(37.5)	1.72(0.80-3.69)
Low level of total dust concentration exposure	32(49.2)	40(62.5)	
Duration of daily working hours			
Over 8 hours	34(52.3)	44(68.8)	0.50(0.23-1.09)
Equal or less than 8 hours	31(47.7)	20(31.2)	
Total duration of cloth work			
Over 6 years	48(73.8)	45(70.3)	1.19(0.52-2.76)
Equal or less than 6 years	17(26.2)	19(29.7)	

Associations between Risk Factors and Wheezing

In this study, there was no statistically significant association between all risk factors and wheezing, as illustrated in Table 11. The result presented that home-based cloth workers who exposed to high level of total dust concentration exposure were 0.84 times less likely to have wheezing breathing sound than those who exposed to low level of total dust concentration exposure (95% CI = 0.32-2.14). Home-based cloth workers who worked over 8 hours a day also were 1.73 times more likely to have wheezing breathing sound than home-based cloth workers who worked equal or less than 8 hours a day (95% CI = 0.64-4.79). Similarly, home-based cloth workers who had total duration of cloth work over 6 years were 3.83 times more likely to have wheezing breathing sound than home-based cloth workers who had total duration of cloth work equal or less than 6 years (95% CI = 0.99-17.24).

Prevalence rate of wheezing among home-based cloth workers with over 8 hours work and over 6 years work were higher than those with 8 hours or less work and 6 years or less work (24.4% VS 15.7% and 25.8% VS 8.3%).

Table 11 Associations between Risk Factors and Wheezing among Home-Based Cloth Workers (N=129)

Risk factors	**Wheezing n(%)**		**OR (95% CI)**
	Yes	**No**	
Level of total dust concentration exposure			
High level of total dust concentration exposure	11(40.7)	46(45.1)	0.84(0.32-2.14)
Low level of total dust concentration exposure	16(59.3)	56(54.9)	
Duration of daily working hours			
Over 8 hours	19(70.4)	59(57.8)	1.73(0.64-4.79)
Equal or less than 8 hours	8(29.6)	43(42.2)	
Total duration of cloth work			
Over 6 years	24(88.9)	69(67.6)	3.83(0.99-17.24)
Equal or less than 6 years	3(11.1)	33(32.4)	

Associations between Risk Factors and Respiratory Symptom(s)

Home-based cloth workers who exposed to high level of total dust concentration exposure were 1.49 times more likely to have at least one of these respiratory symptoms than those who exposed to low level of total dust concentration exposure (95% CI = 0.65-3.43). Moreover, home-based cloth workers who worked over 8 hours a day were 0.55 times less likely to have at least one of these respiratory symptoms than home-based cloth workers who worked equal or less than 8 hours a day (95% CI = 0.23-1.30). Home-based cloth workers who had total duration of cloth work over 6 years also were 1.64 times more likely to have at least one of these respiratory symptoms than home-based cloth workers who had total duration of cloth work equal or less than 6 years (95% CI = 0.68-3.97). However, there was no statistically significant association between risk factors and respiratory symptom(s), as illustrated in Table 12.

Prevalence rate of respiratory symptom(s) among home-based cloth workers with high level of total dust concentration exposure and over 6 years work were higher than those with low level of total dust concentration exposure and 6 years or less work (73.7% VS 65.3% and 72.0% VS 61.1%).

Table 12 Associations between Risk Factors and Respiratory Symptom(s) among Home-Based Cloth Workers (N=129)

Risk factors	**Respiratory symptom(s) n(%)**		**OR (95% CI)**
	Yes	**No**	
Level of total dust concentration exposure			
High level of total dust concentration exposure	42(47.2)	15(37.5)	1.49
Low level of total dust concentration exposure	47(52.8)	25(62.5)	(0.65-3.43)
Duration of daily working hours			
Over 8 hours	50(56.2)	28(70.0)	0.55
Equal or less than 8 hours	39(43.8)	12(30.0)	(0.23-1.30)
Total duration of cloth work			
Over 6 years	67(75.3)	26(65.0)	1.64
Equal or less than 6 years	22(24.7)	14(35.0)	(0.68-3.97)

Associations between Dust Protective Actions and Cough

In this study, the category of dust protective action “Yes” refers home-based cloth workers who always practiced those dust protective actions, and “No” refers to home-based cloth workers who sometimes or never practiced those dust protective actions. On the one hand, Nuntawit Boondesh (B.E.2535), Colton (1993), and Inprasit (1993) found that the effective occupational protective actions must protected the workers from hazard through their work times. For example, using personal protective equipment should be always used, so workers who sometimes used and never used were at risk to expose the hazard which related to occupational respiratory diseases.

There was a statistically significant association between dust protective action (cleansing workplace and devices after work) and cough. Home-based cloth workers who did not clean their workplace and devices after work were 2.82 times more likely to cough than those who cleaned their workplace and devices after work (95% CI = 1.01-7.68).

However, there was no statistically significant association between dust protective actions and cough. Home-based cloth workers who did not use respiratory protective devices were 0.11 times less likely to cough than those who used respiratory protective devices (95% CI = 0.00-1.59). Home-based cloth workers who did not separate their cloth working area from living area were 1.71 times more likely to cough than those who separated their cloth working area from living area (95% CI = 0.47-5.95). Home-based cloth workers who worked in poor workplace ventilation were 2.57 times more likely to cough than those who worked in good workplace ventilation (95% CI = 0.90-7.00). Home-based cloth workers who induced diffusion of dust particles were 1.37 times more likely to cough than those who reduced diffusion of dust particles (95% CI = 0.49-3.85). Home-based cloth workers who did not clean their body and change dressing after work were 0.67 times less likely to cough than those who cleaned their body and changed dressing after work. (95% CI = 0.23-1.94), as shown in Table 13.

Table 13 Associations between Dust Protective Actions and Cough among Home-Based Cloth Workers (N=129)

Dust Protective Actions	Cough n(%)		OR (95% CI)
	Yes	No	
Using respiratory protective devices			
No	22(91.6)	104(99.1)	0.11(0.00-1.59)
Yes	2(8.4)	1(0.9)	
Cleansing workplace and devices after work			
No	13(54.2)	31(29.5)	2.82(1.04-7.68)*
Yes	11(45.8)	74(70.5)	
Separation of working area			
No	5(20.8)	14(13.3)	1.71(0.47-5.95)
Yes	19(79.2)	91(86.7)	
Workplace ventilation			
Poor	14(58.3)	37(35.2)	2.57(0.90-7.00)
Good	10(41.7)	68(64.8)	
Reducing diffusion of dust particles			
No	16(66.7)	63(60.0)	1.37(0.49-3.85)
Yes	8(33.3)	42(40.0)	
Cleansing body after work			
No	16(66.7)	79(75.2)	0.67(0.23-1.94)
Yes	8(33.3)	26(24.8)	

*** = Significant**

Associations between Dust Protective Actions and Phlegm Production

There was a statistically significant association between dust protective action (cleansing workplace and devices after work) and phlegm production. Home-based cloth workers who never cleaned their workplace and devices after work were 2.99 times more likely to bring up phlegm in morning than those who cleaned their workplace and devices after work (95% CI = 1.23-7.28).

Nevertheless, there was no statistical significant association between other dust protective actions and phlegm production. Home-based cloth workers who never used respiratory protective devices were 0.71 times less likely to bring up phlegm in morning than those who used respiratory protective devices (95% CI = 0.05-20.48). Home-based cloth workers who did not separate their cloth working area from living area also were 3.06 times more likely to bring up phlegm in morning than those who separated their cloth working area from living area (95% CI = 1.00-9.34). Home-based cloth workers who worked in poor workplace ventilation were 1.52 times more likely to bring up phlegm in morning than those who worked in good workplace ventilation (95% CI = 0.64-3.62). Home-based cloth workers who induced diffusion of dust particles were 1.22 times more likely to bring up phlegm in morning than those who reduced diffusion of dust particles (95% CI = 0.50-2.99). Home-based cloth workers who never cleaned their body and change dressing after work also were 2.55 times more likely to bring up phlegm in morning than those who cleaned their body and changed dressing after work. (95% CI = 0.83-8.36), as shown in Table 14.

Table 14 Associations between Dust Protective Actions and Phlegm Production among Home-Based Cloth Workers (N=129)

Dust Protective Actions	**Phlegm production n(%)**		**OR (95% CI)**
	Yes	**No**	
Using respiratory protective devices			
No	33(97.1)	93(97.9)	0.71(0.05-20.48)
Yes	1(2.9)	2(2.1)	
Cleansing workplace and devices after work			
No	18(52.9)	26(27.4)	2.99(1.23-7.28)*
Yes	16(47.1)	69(72.6)	
Separation of working area			
No	9(26.5)	10(10.5)	3.06(1.00-9.34)
Yes	25(73.5)	85(89.5)	

Table 14 Associations between Dust Protective Actions and Phlegm Production among Home-Based Cloth Workers (N=129)(Cont.)

Dust Protective Actions	Phlegm production n(%)		OR (95% CI)
	Yes	No	
Workplace ventilation			
Poor	16(47.1)	35(36.8)	1.52(0.64-3.62)
Good	18(52.9)	60(63.2)	
Reducing diffusion of dust particles			
No	22(64.7)	57(60.0)	1.22(0.50-2.99)
Yes	12(35.3)	38(40.0)	
Cleansing body after work			
No	29(85.3)	66(69.5)	2.55(0.83-8.36)
Yes	5(14.7)	29(30.5)	

*** = Significant**

Associations between Dust Protective Actions and Chest Tightness

There was a statistically significant association between dust protective action (cleansing workplace and devices after work) and chest tightness during work. Home-based cloth workers who never cleaned their workplace and devices after work were 3.16 times more likely to have chest tightness during work than those who cleaned their workplace and devices after work (95% CI = 1.25-8.10).

On the other hand, there was no statistically significant association between other dust protective actions and chest tightness during work. Home-based cloth workers who never used respiratory protective devices were 0.14 times less likely to have chest tightness during work than those who used respiratory protective devices (95% CI = 0.00-2.03). Home-based cloth workers who did not separate their cloth working area from living area also were 1.28 times more likely to have chest tightness during work than those who separated their cloth working area from living area (95% CI = 0.36-4.34). Home-based cloth workers who worked in poor workplace ventilation were 2.29 times more likely to have chest tightness during work than those who worked in good workplace ventilation (95% CI = 0.91-5.75). Home-based cloth workers who induced diffusion of dust particles were 1.54 times more likely to have chest tightness during work than those who reduced diffusion of dust particles (95% CI = 0.59-4.10). Home-based cloth workers who never cleaned their body and change dressing after work were 0.60 times less likely to have chest tightness during work than those who cleaned their body and changed dressing after work. (95% CI = 0.23-1.61), as presented in Table 15.

Table 15 Associations between Dust Protective Actions and Chest Tightness during Work among Home-Based Cloth Workers (N=129)

Dust Protective Actions	**Chest tightness n (%)**		**OR (95% CI)**
	Yes	**No**	
Using respiratory protective devices			
No	27(93.1)	99(99.0)	0.14(0.00-2.03)
Yes	2(6.9)	1(1.0)	
Cleansing workplace and devices after work			
No	16(55.2)	28(28.0)	3.16(1.25-8.10)*
Yes	13(44.8)	72(72.0)	
Separation of working area			
No	5(17.2)	14(14.0)	1.28(0.36-4.34)
Yes	24(82.8)	86(86.0)	
Workplace ventilation			
Poor	16(55.2)	35(35.0)	2.29(0.91-5.75)
Good	13(44.8)	65(65.0)	
Reducing diffusion of dust particles			
No	20(69.0)	59(59.0)	1.54(0.59-4.10)
Yes	9(31.0)	41(41.0)	
Cleansing body after work			
No	19(65.5)	76(76.0)	0.60(0.23-1.61)
Yes	10(34.5)	24(24.0)	

*** = Significant**

Associations between Dust Protective Actions and Nasal Congestion

There was no statistically significant association between all dust protective actions and nasal congestion. Home-based cloth workers who never used respiratory protective devices were 0.50 times less likely to have nasal congestion or catarrh during or after work than those who used respiratory protective devices (95% CI = 0.02-7.29). Home-based cloth workers who never cleaned their workplace and devices after work were 1.96 times more likely to have nasal congestion or catarrh during or after work than those who cleaned their workplace and devices after work (95% CI = 0.88-4.42). Home-based cloth workers who did not separate their cloth working area from living area were 0.68 times less likely to have nasal congestion or catarrh during or after work than those who separated their cloth working area from living area (95% CI = 0.23-1.99). Home-based cloth workers who worked in poor workplace ventilation were 1.54 times more likely to have nasal congestion or catarrh during or after work than those who worked in good workplace ventilation (95% CI = 0.71-3.33). Home-based cloth workers who induced diffusion of dust particles were 0.79 times less likely to have nasal congestion or catarrh during or after work than those who reduced diffusion of dust particles (95% CI = 0.36-1.71). Home-based cloth workers who never cleaned their body and change dressing after work were 1.41 times more likely to have nasal congestion or catarrh during or after work than those who cleaned their body and changed dressing after work. (95% CI = 0.60-3.33), as illustrated in Table 16.

Table 16 Associations between Dust Protective Actions and Nasal Congestion among Home-Based Cloth Workers (N=129)

Dust Protective Actions	Nasal congestion n (%)		OR (95% CI)
	Yes	No	
Using respiratory protective devices			
No	63(96.9)	63(98.4)	0.50
Yes	2(3.1)	1(1.6)	(0.02-7.29)
Cleansing workplace and devices after work			
No	27(41.5)	17(26.6)	1.96
Yes	38(58.5)	47(73.4)	(0.88-4.42)
Separation of working area			
No	8(12.3)	11(17.2)	0.68
Yes	57(87.7)	53(82.8)	(0.23-1.99)
Workplace ventilation			
Poor	29(44.6)	22(34.4)	1.54
Good	36(55.4)	42(65.6)	(0.71-3.33)
Reducing diffusion of dust particles			
No	38(58.5)	41(64.1)	0.79
Yes	27(41.5)	23(35.9)	(0.36-1.71)
Cleansing body after work			
No	50(76.9)	45(70.3)	1.41
Yes	15(23.1)	19(29.7)	(0.60-3.33)

Associations between Dust Protective Actions and Wheezing

There was no statistically significant association between dust protective actions and wheezing. Home-based cloth workers who never used respiratory protective devices were 0.52 times less likely to have wheezing breathing sound than those who used respiratory protective devices (95% CI = 0.03-15.10). Home-based cloth workers who never cleaned their workplace and devices after work were 1.75

times more likely to have wheezing breathing sound than those who cleaned their workplace and devices after work (95% CI = 0.68-4.53). Moreover, home-based cloth workers who did not separate their cloth working area from living area were 1.96 times more likely to have wheezing breathing sound than those who separated their cloth working area from living area (95% CI = 0.58-6.41). Home-based cloth workers who worked in poor workplace ventilation also were 1.07 times more likely to have wheezing breathing sound than those who worked in good workplace ventilation (95% CI = 0.41-2.74). Home-based cloth workers who induced diffusion of dust particles also were 1.34 times more likely to have wheezing breathing sound than those who reduced diffusion of dust particles (95% CI = 0.51-3.61). Home-based cloth workers who never cleaned their body and change dressing after work were 0.81 times less likely to have wheezing breathing sound than those who cleaned their body and changed dressing after work. (95% CI = 0.29-2.31), as illustrated in Table 17.

Table 17 Associations between Dust Protective Actions and Wheezing among Home-Based Cloth Workers (N=129)

Dust Protective Actions	**Wheezing n (%)**		**OR (95% CI)**
	Yes	**No**	
Using respiratory protective devices			
No	26(96.3)	100(98.0)	0.52
Yes	1(3.7)	2(2.0)	(0.03-15.10)
Cleansing workplace and devices after work			
No	12(44.4)	32(31.4)	1.75
Yes	15(55.6)	70(68.6)	(0.68-4.53)
Separation of working area			
No	6(22.2)	13(12.7)	1.96
Yes	21(77.8)	89(87.3)	(0.58-6.41)
Workplace ventilation			
Poor	11(40.7)	40(39.2)	1.07
Good	16(59.3)	62(60.8)	(0.41-2.74)

Table 17 Associations between Dust Protective Actions and Wheezing among Home-Based Cloth Workers (N=129) (Cont.)

Dust Protective Actions	Wheezing n (%)		OR (95% CI)
	Yes	No	
Reducing diffusion of dust particles			
No	18(66.7)	61(59.8)	1.34
Yes	9(33.3)	41(40.2)	(0.51-3.61)
Cleansing body after work			
No	19(70.4)	76(74.5)	0.81
Yes	8(29.6)	26(25.5)	(0.29-2.31)

Associations between Dust Protective Actions and Respiratory Symptom(s)

There was no statistically significant association between dust protective actions and respiratory symptom(s). All home-based cloth workers who used respiratory protective devices had at least one of these respiratory symptoms. Home-based cloth workers who never cleaned their workplace and devices after work were 2.23 times more likely to have at least one of those respiratory symptoms than those who cleaned their workplace and devices after work (95% CI = 0.88-5.76). Home-based cloth workers who did not separate their cloth working area from living area were 1.82 times more likely to have at least one of those respiratory symptoms than those who separated their cloth working area from living area (95% CI = 0.51-7.05). Home-based cloth workers who worked in poor workplace ventilation were 1.82 times more likely to have at least one of those respiratory symptoms than those who worked in good workplace ventilation (95% CI = 0.77-4.36). Home-based cloth workers who induced diffusion of dust particles were 0.93 times more likely to have at least one of those respiratory symptoms than those who reduced diffusion of dust particles (95% CI = 0.40-2.14). Home-based cloth workers who never cleaned their body and change dressing after work were 1.09 times more likely to have at least one of those respiratory symptoms than those who cleaned their body and changed dressing after work. (95% CI = 0.43-2.72), as shown in Table 18.

Table 18 Associations between Dust Protective Actions and Respiratory Symptom(s) among Home-Based Cloth Workers (N=129)

Dust Protective Actions	Respiratory symptom(s) n (%)		OR (95% CI)
	Yes	No	
Using respiratory protective devices			
No	86(96.6)	40(100)	0
Yes	3(3.4)	0(0)	(0.00-5.06)
Cleansing workplace and devices after work			
No	35(39.3)	9(22.5)	2.23
Yes	54(60.7)	31(77.5)	(0.88-5.76)
Separation of working area			
No	15(17.2)	4(9.5)	1.82
Yes	74(82.8)	36(90.5)	(0.51-7.05)
Workplace ventilation			
Poor	39(44.8)	12(28.6)	1.82
Good	50(55.2)	28(71.4)	(0.77-4.36)
Reducing diffusion of dust particles			
No	54(62.1)	25(59.5)	0.93
Yes	35(37.9)	15(40.5)	(0.40-2.14)
Cleansing body after work			
No	66(75.9)	29(69.0)	1.09
Yes	23(24.1)	11(31.0)	(0.43-2.72)

CHAPTER V
DISCUSSION

In this chapter, background characteristics, risk factors, dust protective actions, and testing of hypotheses were initially presented and discussed. Discussion of factors associated with respiratory symptoms among home-based cloth workers was being followed.

Background Characteristics

Among the 258 subjects, 80.6% were females. The average of age was 37 years old (S.D.= 10.77) with a range between 16 and 59 years old. The average of years of education was 6 years (S.D.= 4.0). The majority of the subjects had 4 years of education or Phathomsucksa 4 (43.8%). The average of monthly income was 4243.37 bath (S.D.= 187.33). The majority had monthly income 4,000 bath (24.9%). About 91.5% of the subjects reported that they did not have respiratory illness in the past year. The majority of all subjects were non-smoker (86.4%), whereas 10.1% used to smoke. Only 3.5% of the subjects were recent smoker. About a half of the subjects were home-based cloth workers. Other occupations were merchant, employee, government civil, agriculture and miscellaneous (17.4%, 12.8%, 7.4%, 1.9% and 10.5%, respectively).

In this study, exposure group was 129 home-based cloth workers in Bansang subdistrict who had been working in home-based cloth workplace at least 6 months to the date of data collection. Non-exposure group was randomly selected from persons aged over 15 years who lived in Bansang subdistrict, and worked in a non home-based cloth workplace. Using a one to one ratio, the same number of non home-based cloth workers were recruited into a non-exposure group.

The comparisons of background characteristics between the exposure and non-exposure groups were analyzed using a t-test (age, years of education and monthly income) and a Chi-square test (sex, past respiratory illness, cigarette smoking history and occupation). There were no statistically significant difference in sex, monthly income, past respiratory illness and cigarette smoking history between these groups ($p > 0.05$). Nevertheless, there were statistically significant differences in age ($p<.05$) and years of education ($p<.001$). From these significant different characteristics reviewed, the several studies postulated that age was no statistically significant association with occupational respiratory symptoms (Boondesh, 1992; Borribunetrup, 1994; Chaikittiporn, 1979; Cheanbumrung, 1982; Christiani, 2001; Douwes, 2000; and Kilburn et. al., 1985). A year of education of non-exposure group was higher than the exposure group because people who were high educational level had more chances for occupation choices. In contrast, the exposure group had fewer opportunities to choose their occupation because of limited educational level. The three factors of poor health cycle (poor educational level, low income, and illness) could describe these at risk population as follow. The majority of home-based cloth workers had limited education, so they were not perceived their occupational hazardous and occupational health protections were deniable. Moreover, several studies shown that there was no statistically significant association between educational level and occupational respiratory symptoms among policemen (Boondesh, 1992), textile workers (Borribunetrup, 1994; Cheanbumrung, 1982; Christiani, 2001; Douwes, 2000; and Kilburn et. al., 1985), and animal-feed workers (Watcharavitoon, 1997).

Hypothesis one: There are significant associations between home-based cloth work and reported respiratory symptoms (cough, phlegm production, chest tightness, nasal congestion, wheezing, and respiratory symptom(s)).

The result of this study demonstrated that there were statistically significant associations between respiratory symptoms and home-based cloth work.

Data analysis by Odds ratio and 95% confidence interval shown that home-based cloth workers were 3.46 times more likely to cough a wakening than non-home-based cloth workers (95% CI = 1.40-8.77). The result of this study supports the hypothesis that there are significant associations between home-based cloth work and cough. This finding is in agreement with the Heederik (1994: 127-129) and Rylander (1994: 118) which found that cough was a result of a chronic exposure to organic dust.

From the interview, it was found that cough of home-based cloth workers will be absence when they laid off home-based cloth work for several months (6-12 months).

The result presented that home-based cloth workers also were 4.26 times more likely to bring up phlegm in morning than non home-based cloth workers (95% CI = 1.90-9.75). This finding was in accordance with several studies (Kilburn, 1985; Massin, 1991:559-560; Mathison, 1982:129; and Robinson, 1994) which found that excess mucus production was a characteristic of a chronic inflammation in the airways that due to chronic organic dust exposure. Heederik and Smid (1994: 127-129) also postulated that organic dust exposure was responsible for the development of chronic bronchitis and hypersensitivity pneumonitis.

Moreover, those with home-based cloth work were 6.98 times more likely to have chest tightness during work than those who were non home-based cloth workers (95% CI = 3.08-16.24). Many studies (Kilburn, 1985; and Morgan & Seaton, 1986) reported that chest tightness during the first day at work was the most common symptom of textile workers. Nevertheless, the chest tightness symptoms extended to other days and might be accompanied by severe respiratory impairment because of continued dust exposure (Schilling and Rylander, 1994: 180). Additionally, while chest tightness is used in indicated severity of textile workers' respiratory problems, presence of chest tightness among home-based cloth workers can give early alarm for the needs of prevention program regarding occupational respiratory diseases.

Home-based cloth workers were 3.84 times more likely to have nasal congestion or catarrh during or after work than those who were non home-based cloth workers (95% CI = 2.15-6.89). This finding is accordance with many studies (Heederik and Smid, 1994:127-129; Hogen, 1993: 188-190; Raza et al, 1999; and Rylander, 1994: 121) which postulated that organic dust exposure reaction were a contact hypersensitivity or a general hyperreactivity such as catarrh, which trigged by organic dust deposition on the epithelium surface of the upper respiratory pathways among textile workers.

People who were home-based cloth workers were 4.61 times more likely to have wheezing sound than those who were non home-based cloth workers (95% CI = 1.82-12.18). This finding is similar to Schachter's report (Schachter, 1994:215) that bronchoconstriction was a characteristic of a common occupational disease that had been found in worker processing hemp, cotton, and flax.

Home-based cloth workers were 3.75 times more likely to have at least one of these respiratory symptoms than non home-based cloth workers (95% CI = 2.17-6.51). Several studies illustrated that chronic dust exposure workers at risk to occupational respiratory disease had these common respiratory symptoms (Chaikittiporn, 1979; Cheanbumrung, 1982; Hogen, 1993: 188-190; Kilburn, 1985; Lee et al, 1997; Li et al, 1987; Lu et al, 1987; Morgan & Seaton, 1986; Ong et al, 1987; Raza et al, 1999; Robinson, 1994; Schachter, 1994:215; and Schilling, 1956).

In summary, home-based cloth work was significantly associated with respiratory symptoms including cough, phlegm production, chest tightness, nasal congestion and wheezing [OR = 3.46 (1.40-8.77), 4.26 (1.90-9.75), 6.98 (3.08-16.24), 3.84 (2.15-6.89) and 4.61 (1.82-12.18)]. Additionally, home-based cloth work was significantly associated with respiratory symptom(s) [OR = 3.75 (2.17-6.51)]. Cough, phlegm production, chest tightness and wheezing similar textile workers' respiratory problems and chronic bronchitis in long run (Bouhuys & Zuskin, 1980; Schachter, 1994; and Spencer, 1968) and decrease work efficacy (Spencer, 1968); while nasal congestion is a symptom of hypersensitivity which disturbs quality of workers' life (Bouhuys & Zuskin, 1980). Thus, it is important that prevention program regarding occupational respiratory diseases should be implemented before onset of these diseases.

Hypothesis two: There are significant associations between risk factors (level of total dust concentration exposure, duration of daily working hours, and total duration of cloth work) and respiratory symptoms (cough, phlegm production, chest tightness, nasal congestion, wheezing, and respiratory symptom(s)) among home-based cloth workers.

The result of this study demonstrated that there was a statistically significant association between level of total dust concentration exposure and cough.

Home-based cloth workers who exposed to high level of total dust concentration (over 5 mg/m^3) were 3.12 time more likely to cough than home-based cloth workers who exposed to low level of total dust concentration (equal or less than

5 mg/m^3) (95% CI= 1.13-8.84). Similarly, the several studies stated that level of total dust concentration exposure associated with respiratory problem of textile workers and respiratory symptoms such as cough, excess phlegm production, chest tightness and wheezing sound (Bouhuys and Zuskin 1980; Cheanbumrung, 1982; Christiani, 2001; Heederik and Smid, 1994; Lee et al, 1997; Massin, 1987:555-560; and Smith & Patton, 1999: Abstract). High level of total dust concentration exposure also was a risk factor of phlegm production, chest tightness, nasal congestion and respiratory symptom(s) [OR= 1.17(0.50-2.76), 1.77(0.71-4.42), 1.72(0.80-3.69) and 1.49(0.65-3.43), respectively]. However, these associations were not statistically significant.

The result of this study presented that about 44.1% of home-based cloth workers in Bansang subdistrict exposed to high level of total dust concentration, so occupational respiratory disease protective program should be given to these workers.

Duration of daily working hours was a risk factor of phlegm production and wheezing [OR= 1.08(0.45-2.60) and 1.73(0.64-4.79)]. However, these associations were not statistically significant. It was found that home-based cloth workers who worked over 8 hours a day were more likely to bring up phlegm in the morning and wheezing sound than home-based cloth workers who worked equal or less than 8 hours a day. Similarly, the several studies shown that duration of dust exposure was associated with declined pulmonary function test (Nuntawit Boondesh, B.E. 2535; Chaikittiporn, 1987; Cheanbumrung, 1982; Christiani et al, 2001: Abstract; Raza et al, 1999: Abstract).

From this study, more than a half of home-based cloth workers in Bansang subdistrict worked 8 to 10 hours a day (65.9%), so that these home-based cloth workers were at risk to the respiratory problems. Thus, effective dust protective actions should be used throughout their work time.

Moreover, total duration of cloth work was associated with phlegm production, chest tightness, nasal congestion wheezing and respiratory symptom(s) [OR= 1.10(0.42-2.93), 1.02(0.37-2.85), 1.19(0.52-2.76), 3.83(0.99-17.24) and 1.64(0.68-3.97), respectively]. Although these associations were not statistically significant, the result of this study presented that home-based cloth workers who had total duration of cloth work over 6 years were more likely to have all respiratory symptoms of this study than home-based cloth workers who had total duration of cloth work equal or less than 6 years. The average of total duration of cloth work of those home-based cloth workers was 13.5 years with the range of 32 to 1 year, and 76% of those home-based cloth workers had total duration of cloth work over 6 years.

As a result that risk factors (level of total dust concentration exposure, duration of daily working hours, and total duration of cloth work) were associated with respiratory symptoms among home-based cloth workers, occupational preventive programs should be given to these home-based cloth workers.

Hypothesis three: There are significant associations between dust protective actions (using respiratory protective devices, cleansing workplace and devices after work, separation of working area, workplace ventilation, reducing diffusion of dust particle, and cleansing body after work) and respiratory symptoms (cough, phlegm production, chest tightness, nasal congestion, wheezing, and respiratory symptom(s)) among home-based cloth workers.

The results of this study shown that there were statistically significant associations between dust protective actions (cleansing workplace and devices after work) and respiratory symptoms (cough, phlegm production, and chest tightness) among home-based cloth workers.

Cleansing workplace and devices after work was a dust protective action that significantly decreased risk to respiratory symptoms such as cough, phlegm production, and chest tightness among home-based cloth workers. It was found that home-based cloth workers who did not clean their workplace and devices after work were more likely to cough, bring up phlegm, and have chest tightness than home-based cloth workers who cleaned their workplace and devices after work [OR = 2.82(1.04-7.68), 2.99(1.23-7.28) and 3.16(1.25-8.10)]. From observation during data collecting period, method of cleansing workplace and devices after work of those workers were dry cleansing method such as sweeping with a bloom. Sweeping can induce diffusion of dust particles in their workplaces. If they used wet mop up, Odds ratio of these associations might be greater. Similarly, Chanlett (1979) suggested that wet methods to reduce dust release are effective, while work equipment, and workplace should be cleaned every time after or before start working because the dust particles on the equipment will be cleaned up, so exposure will be reduced. Programs of healthy workplace should be conducted among these home-based cloth workers. More appropriate cleansing method should be advised.

In contrast, the result of this study stated that home-based cloth workers who sometimes or never used respiratory protective devices were less likely to cough, bring up phlegm, have chest tightness, have nasal congestion, have wheezing sound, and present with at least one of these respiratory symptoms than home-based cloth workers who always used respiratory protective devices [OR = 0.11(0.00-1.59), 0.71(0.05-20.48), 0.14(0.00-2.03), 0.50(0.02-7.29), 0.52(0.03-15.10) and 0(0.00-5.06), respectively] but not statistically significant. Similarly, several studies illustrated that using respiratory protective devices was associated with reduced lung function among textile workers, policemen, and animal-feed workers (Cuwichian Borribunetrup, B.E. 2537; Nuntawit Boondesh, B.E. 2535; and Pornpan Watcharavitoon, B.E. 2542). During data collection, the investigator found that those dust protective devices used by home-based cloth workers were only simple cloth masks. If they used the high quality protective mask, Odds ratio of these associations may be higher than 1. From interviewed, these dust protective devices user had never clean their mask after work and they used them 1 to 2 months per piece. This means that the odd of developing these respiratory symptoms among non-device users should be greater than that of the users. Occupational health education about selection of respiratory protective devices and motivation to use these devices should be given to these workers. Frequency of protective device use will be increased (Cuwichian Borribunetrup, B.E. 2537: 87). The study of dust protective masks that can protect dust in home-based cloth workers should be applied in practice.

This finding suggested that separation of working area was associated with cough, phlegm production, chest tightness, wheezing, and respiratory symptom(s). Home-based cloth workers who did not separate their working area from living area were more likely to cough, bring up phlegm, have chest tightness, have wheezing sound, and at least one of these respiratory symptoms than home-based cloth workers who separated their working area from living area [OR = 1.71(0.47-5.95), 3.06(1.00-9.34), 1.28(0.36-4.34), 1.96(0.58-6.41) and 1.82(0.51-7.05)]. However, these associations were not statistically significant because separations in this study were not clearly defined. Their workplace and living units were shareable.

Good workplace ventilation was associated with cough, phlegm production, chest tightness, nasal congestion, wheezing, and respiratory symptom(s). Home-based cloth workers who worked in poor ventilation workplace were more likely to cough, bring up phlegm, have chest tightness, have nasal congestion, have wheezing sound, and at least one of these respiratory symptoms than home-based cloth workers who worked in good ventilation workplace [OR = 2.57(0.90-7.00), 1.52(0.64-3.62), 2.29(0.91-5.75), 1.54(0.71-3.33), 1.07(0.41-2.74) and 1.82(0.77-4.36)]. However, these associations were not statistically significant because condition of good and poor ventilation workplace was not distinguishingly different. For example, there was no very good and very poor ventilation workplace. There was no workplace in this study, which had engineering ventilation management.

Moreover, the result shown that reducing diffusion of dust particles was associated with cough, phlegm production, chest tightness, and wheezing. Home-based cloth workers who put an electric fan into their working area were more likely to cough, bring up phlegm, have chest tightness, and have wheezing sound than home-based cloth workers who did not turn on an electric fan into their working area [OR = 1.37(0.49-3.85), 1.22(0.50-2.99), 1.54(0.59-4.10) and 1.34(0.51-3.61)]. However, these associations were not statistically significant.

Cleansing body after working also was associated with phlegm production, nasal congestion, and respiratory symptom(s). However, these associations were not statistically significant because it is hard to clean and change their dressing after work immediately. Some home-based cloth workers who were employee spent their time after work on traffic transportation back home. Work cloth should be changed after work before they went their home. Health education on protective health behaviors should be conducted to these home-based cloth workers.

The results of this study can provide support for understanding risk factors of respiratory symptoms and dust protective actions, which decreased respiratory symptoms among home-based cloth workers in Bansang subdistrict, Ayutthaya Province. The research findings can give a contribution and benefit to guide specific intervention regarding occupational respiratory disease protection.

CHAPTER VI
CONCLUSION

Research Conclusions

This cross-sectional study was conducted to examine the associations between home-based cloth work and respiratory symptoms, risk factors and respiratory symptoms, and dust protective actions and respiratory symptoms among home-based cloth workers in Bansang subdistrict, Ayutthaya Province. Two research instruments, four parts of questionnaires and personal dust samplers with dust analyzed were used in this study. The questionnaires were constructed by the investigator based on the literature reviewed and validated contents by the expert occupational respiratory physician. Personal dust samplers were GILIAN ® (Gil Air-5 model) which were always calibrated by GILIAN Gilibrator 2 VER 4.0 before use.

The research subjects were 258 people who lived in Bansang subdistrict. Using a one to one ratio, the same number of non home-based cloth workers were recruited into a non-exposure group by a simple random sampling technique without replacement. Two subjects of non-exposure group and 9 home-based cloth workers from 9 different workplaces were selected for cloth dust exposure measurement of total dust concentration and size.

Data was collected by home visit. The investigator read all questionnaires in order to get the answer. Dust collection methods were Total Suspended Particle (TSP) under the average of temperature 29.5^0 C and 1013.4 Millbrae of atmosphere pressure. Dust was collected and analyzed by Technician of Department of Environmental Science, Faculty of Science, Silpakorn University Nakorn Pathom.

SPSS was used to analyze descriptive statistics. Background characteristic data of exposure group and non-exposure group were compared by chi-square test or t-test, as appropriate. Epi info V.6 was used to analyze associations between home-based cloth work and respiratory symptoms, risk factors and respiratory symptoms, and dust protective actions and respiratory symptoms.

Among the 258 subjects, 80.6% were females. The average of age was 37 years old (S.D.= 10.77) with a range between 16 and 59 years old. The average of years of education was 6 years (S.D.= 4.0). The majority of the subjects had 4 years of education or Phathomsucksa 4 (43.8%). The average of monthly income was 4,243.37 bath (S.D.= 187.33). The majority had monthly income 4,000 bath (24.9%). About 91.5% of the subjects did not have respiratory illness in the past year. The majority of all subjects were non-smoker (86.4%), whereas 10.1% used to smoke. Only 3.5% of the subjects were recent smoker. About a half of the subjects were home-based cloth workers. Other occupations were merchant, employee, government civil, agriculture and miscellaneous (17.4%, 12.8%, 7.4%, 1.9% and 10.5%, respectively).

The result of this study revealed that there were statistically significant associations between home-based cloth work and respiratory symptoms including: cough [OR = 3.46(1.40-8.77)], phlegm production [OR = 4.26(1.90-9.75)], chest tightness [OR = 6.98, (3.08-16.24)], nasal congestion [OR = 3.84(2.15-6.89)], wheezing [OR = 4.61(1.82-12.18)] and at least one of these respiratory symptoms [OR = 3.75(2.17-6.51)]. The longitudinal study of this group should be followed. Moreover, there was statistically significant associations between level of dust particle exposure and cough [OR = 3.12(1.13-8.84)], cleansing workplace and devices after work and cough [OR = 2.82(1.04-7.68)], cleansing workplace and devices after work and phlegm production [OR = 2.99(1.23-7.28)] and cleansing workplace and devices after work and chest tightness [OR = 3.16(1.25-8.10)].

In summary, information gained from this study should be utilized to improve occupational respiratory disease protective planning among home-based cloth workers in Bansang subdistrict and those in Ayutthaya Province. Cleansing workplace and devices after work is a suggested dust protective action among these home-based cloth workers, and wet cleansing method should be advised. The efficacious protective mask also should be applied in this group. Additionally, programs of healthy workplace should be rapidly conducted to these home-based cloth workers.

Limitation of This Study

Data of this study were collected during December 2002 and March 2003, which was low productive period for home-based cloth work in Bansang subdistrict because of short winter, so not many cloth products were ordered During this time, some of home-based cloth workers went back to their parent home outside Ayutthaya Province. Some of home-based cloth workers were Burmese who could not understand and answer the questionnaires, so they are not included in this study.

Because of the constrained budget, a sample for dust measurements was slightly small about 11 subjects and they were not good representatives to all home-based cloth workplaces in this study.

Recommendations for Health Care Providers

The result of this study suggested that home-based cloth workers were at greater the risk of respiratory problems than non home-based cloth workers. Therefore, intervention strategies regarding surveillance and prevention of respiratory disease should be given to these people. Nursing intervention should focus on using effective respiratory protective device and health education regarding workplace-cleansing method and appropriate health behavior after work. Moreover, yearly health check up should be encouraged among them. Occupational health education of appropriate occupational respiratory disease protection should be implemented to these subjects. Consequently, prevention of respiratory disease among these home-based cloth workers will be ensured.

Changing health protective behaviors in home-based cloth workers is difficult because they think that they are still healthy and dust hazard was never shown. Currently, result of dust measurement in this study illustrated that there were harms around their breathing zone. Therefore implementation of programs regarding occupational respiratory protective actions should be started before disease onset.

From the comparison of respiratory morbidity rate in chapter I, Bansang Health Care Center had the highest one in 1999 to 2001 (9065, 8238 per 100,000 population and 7556 per 100,000 of population, respectively). Health care providers should explore patients with respiratory illness who seek health care at Bansang Health Care

Center about their occupations. There might be evidence of significant association between home-based cloth work and these high respiratory morbidity.

Recommendations for Nursing Research

1. Longitudinal study to follow up respiratory symptoms and pulmonary function parameter among these home-based cloth workers is recommended.
2. Research of association between home-based cloth work and a high respiratory morbidity in Bansang subdistrict should be conducted.
3. Experimental research should be carried out to improve dust protective actions such as using high quality protective mask, workplace cleansing technique, and healthy behavior, with affordable and acceptable technology.

BIBLIOGRAPHY

Aas, K. (1993). Qualit of air – quality of life for children. In K. Ekberg, & P.E. Mjaavatn (Eds), Children at risk: selected papers (pp. 49-62). Norway: Trondheim.

Achmadi, U.F. (1993). The socio-environmental factors and the acute respiratory infection episode among children under five in Jakarta. In K. Ekberg, & P.E. Mjavatn (Eds), Children at risk: selected papers (pp. 63-77). Norway: Trondheim.

Austin, E., Brock, J., & Wissler, E. (1979). A model for deposition of stable and unstable aerosols in the human respiratory tract. American Industrial Hygiene Association Journal, 40(12), 1055-1067.

Banks, D.E., & Wang, M.L. (2000). Occupational asthma: the big picture. Occupational Medicine, 15(2), 335-358.

Barnes, P.J. (1989). New concepts in the pathogenesis of bronchial hyperresponsiveness and asthma. Journal of Allergy Clinical Immunology, 83 (6), 1013-1024.

Bernstein, I.L. (1982). Occupational asthma: coming of age. Annals of Internal Medicine, Vol.97(1), 125-127.

Bouhuys, A., & Zuskin, E. (1980). Byssinosis: occupational lung disease in textile workers. In C.A. Frazier, Occupational asthma. New York: Van Nostrand Reinhold Company.

Chaikittiporn, C (1979). Health effect of cotton dust exposure a six – year follow-up study. Ph.D. Thesis in Public Health (Epidemiology). College of Public Health, University of the Philippines Manila.

Chanlett, E.T. (1979). Environmental protection (2nd ed.). Tokyo: McGraw- Hill Kogakusha.

Cheanbumrung, K (1982). The allergy to cotton dust in cotton mill workers of Samut Prakarn province. M.A. Thesis in Science (Epidemiology), Faculty of Graduate Studies, Mahidol University.

Cherniack, N.S., Altose, M.G., & Kelsen, S.G. (1988). The respiratory system. In R.M. Berne & M.N. Levy (Eds.), Physiology (2nd ed., pp. 575-648). St. Louis: The C.V. Mosby.

Christiani, D.C. et al. (2001). Longitudinal changes in pulmonary function and respiratory symptom in cotton textile workers: a 15 year follow-up study. Am-J-Respi-Crit-Care-Med. [CD-ROM], 163 (4), pp. 847-853. Abstract from: MEDLINE (R) on CD 2001/ 07-2001/ 08. [2001, November 28].

Colton, C.E. (1993). Respiratory protection. In B.A. Plog, J. Niland, & P.J. Quinlan, Fundamentals of industrial hygiene (4th ed., pp. 619-628). Hasca: National Safety Council.

Corn, J.K. (1992). Response to occupational health hazards: a historical perspective. New York: Van Nostrand Reinhold.

Danse, I.R. (1991). Common sense toxics in the workplace. New York: Van Norstrand Reinhold.

Douwes, J. et al (2000). Workers exposure to airborne dust, endotoxin and beta(1,3)-glucan in two New Zealand sawmills. Am-J-Ind-Med. [CD-ROM], 38 (4), pp. 426-430. Abstract from: MEDLINE (R) 2000. [2001, November 28].

Fox, A.J. et al., .(1973). A survey of respiratory disease in cotton operative part II : symptoms, dust estimations, and the effect of smoking habit. British Journal of Industrial Medicine, 30, 48-53.

Goldstein, B.D., & Gotsch, A.R. (1994). Risk communication. In L. Rosenstock, & M.R. Cullen (Eds), Textbook of clinical occupational and environmental medicine. Philadelphia: WB. Saunder.

Guenter, C.A., Welch, M.H., & Hogg, J.C. (1978). Clinical aspects of respiratory physiology. Philadelphia: Lippincott.

Heederik, D., & Smid, T. (1994). Epidemiology: mortality and morbidity. In R. Rylander, & R.R. Jacobs. (Eds.), Organic dust: exposure, effects, and prevention (pp. 127-138). Boca Raton: Lewis.

Hogan, T.J. (1993). Particulates. In B.A. Plog, J. Niland, & P.J. Quinlan, Fundamentals of industrial hygiene (4th ed., pp. 175-196). Hasca: National Safety Council.

Hosey, A.D.(1973). General principles in evaluating the occupational environment. In G.D. Clayton, The industrial environment – its evaluation & control (pp. 95-100). Washington D.C.: U.S. Government Printing Office.

Jacobs, R.R. (1994). Risk environment. In R. Rylander, & R.R. Jacobs. (Eds.), Organic dust: exposure, effects, and prevention (pp. 1-32). Boca Raton: Lewis.

_________ . (1994). Exposure assessment. In R. Rylander, & R.R. Jacobs. (Eds.), Organic dust: exposure, effects, and prevention (pp. 43-58). Boca Raton: Lewis.

Jensen, P.A. & O'Brien, D. (1993). Industrial hygiene. In K. Willeke, & P.A. Baron, Aerosol measurement principle, techniques, and application (pp. 537-563), New York: Van Nostrand Reinhold.

Kampen, V., Merget, R., & Baur, X. (2000). Occupational airway sensitizers: an overview on the respective literature. AM-J-Ind-Med. [CD-ROM], 38 (2), pp. 164-218. Abstract from: MEDLINE (R) 2000. [2001, November 28].

Keith, W.M., Morgan, C., & Seaton, A. (1975). Occupational lung diseases. Philadelphia: WB. Saunder.

Kilburn, K.H., Warshaw, R., & Thornton, J.C. (1985). Pulmonary functional impairment and symptoms in women in the Los Angeles harbor area. The American Journal of Medicine, Vol. 79, 23-35.

Kim,H.Y. et al (1999). Occupational asthma and IgE sensitization to cellulase in a textile industry workers. Ann-Allergy-Asthma-Immunolo. [CD-ROM], 82 (2), pp. 174-178. Abstract from: MEDLINE (R) 1999 Part A. [2001, November 28].

Kloss, D. (1989). Occupational health law. Oxford: BSP Professional Book.

Lee, B.W., Kelsey, K.T., Hashimoto, D.,Yakes, B., Seitz, T., & Christiani, D.C. (1997). The prevalence of pulmonary and upper respiratory tract symptoms and spirometric test finding among newspaper pressroom workers exposed to solvents. Journal of Occupational and Environmental Medicine, Vol.39 (10), 960- 969.

Lehtimaki, M., & Willeke, K. (1993). Measurement methods .In K. Willeke, & P.A. Baron, Aerosol measurement principle, techniques, and application, . New York: Van Nostrand Reinhold.

Levy, B.S., & Wegman, D.H. (1988). Occupational health recognizing and preventing work – related disease. (2nd ed.). Toronto: Little, Brown and Company.

Lie, D.H. et al. (1987). Preliminary approach to the diagnosis of byssinosis. American Journal of Industrial Medicine, Vol.12(6), 731-735.

Lie, M.S. (1987). The health investigation of cotton textile workers in Baijing. American Journal of Industrial Medicine, Vol.12(6), 743-753.

Lu, P.L., et al. (1987). The study of byssinosis in China: a comprehensive report. American Journal of Industrial Medicine, Vol.12(6), 743-753.

Maizlish, N.A. (Ed.). (2000). Workplace Health Surveillance: an action- oriented approach. New York: Oxford University Press.

Mangino, M.M. (2000). The aging employee: impact on occupational health. American Association of Occupational Health Nursing Journal, Vol. 48(7), 349- 358.

Martini, F.H., et al. (1998). Fundamentals of anatomy and physiology (4th ed.). New Jersey: Prentice Hall.

Massin, N., et al. (1991). A study of prevalence of acute respiratory disorders among workers in the textile industry. International of Archives of Occupational Environment Health, Vol.62(8), 555-560.

Mathison, D.A.,Stevenson, D.D., & Simon, R.A. (1982). Asthma and the home environment. Annals of Internal Medicine, Vol.97(1), 128-130.

McFarland, A.R., Hickman, P.D., & Parnell, C.B. (1987). A new cotton dust sampler for PM-10 aerosol. American Industrial Hygiene Association Journal, 48(3), 293-297.

Merchant, J.A. et al. (1973b). An industrial study of the biological effects of cotton dust and cigarette smoke expose. Journal of Occupational Medicine, 15, 212-221.

Morgan, W.K. (1986). Pulmonary physiology. In L. Rosenstock, & M.R. Cullen (Eds), Clinical occupational medicine. Philadelphia: WB. Saunder.

Moscato, G. et al (1999). Occupational asthma: a longitudinal study on the clinical and socioeconomic outcome after diagnosis. Chest, 115 (1), pp. 249-256.

Mutchler, J.E. (1973). Principles of ventilation. In G.D. Clayton, The industrial environment – its evaluation & control (pp. 573-583). Washington D.C.: U.S. Government Printing Office.

National Institute for Occupational Safety and Health. (1977). A Recommended Standard for Occupational Exposure to cotton dust. Washington D.C.: Dhew (NIOSH).

Nicholls, P.J., & Skidmore, J.W. (1975). Comparative study of the smooth muscle contractor activity of airborne dusts and of dustiness in cotton, flax, and jute mills. British Journal of Industrial Medicine, 32, 289-296.

Obase, Y. (2000). Two patients with occupational asthma who returned to work with dust respirators. Occup-Environ-Med. [CD-ROM]. 57 (1), pp. 62-64. Abstract from: MEDLINE (R) 2000. [2001, Novenber 28].

Ong, S.G. (1987). Byssinosis and other respiratory problems in the cotton industry of Hong Kong. American Journal of Industrial Medicine, Vol.12(16), 773-777.

Pairoj-Boriboon, S.,(Ed.). (1989). Laws and standards on pollution control in Thailand (2nd ed.). Bangkok: Environmental Quality Standard Division Office of the National Environment Board Thailand.

Parkes, W.R. (1994). Occupational lung disorders,(3rd ed.). Oxford: Butterworth-Heinemann.

Raffle, P.A.B., Lee, W.R., McCallum,, R.I., & Murra, R. (1987). Hunter's diseases of Occupations. Boston: Little, Brown & Company.

Raza, S.N. et al (1999). Respiratory symptoms in Lancashire textile weavers. Occup-Environ-Med. [CD-ROM], 56 (8), pp. 514-519. Abstract from: MEDLINE (R) 1999 Part A. [2001, November 28].

Roach, S.A. (1973). Sampling air for particulate. In G.D. Clayton, The industrial environment – its evaluation & control (pp. 139-154). Washington D.C.: U.S. Government Printing Office.

Robinson, B.W. (1994). Cell reactions. In R. Rylander, & R.R. Jacobs. (Eds.), Organic dust: exposure, effects, and prevention (pp. 95-107). Boca Raton: Lewis.

Rosenstock, L., & Cullen, M.R. (1986). Clinical occupational medicine. Philadelphia: WB. Saunders.

Rylander. (1994). Organic dust: exposure, effects, and prevention. Boca Raton: Lewis.

Schachter, E.N. (1994). Byssinosis and other textile dust- related lung diseases. In L. Rosenstock & M.R. Cullen (Eds.), Textbook of clinical occupational and environment medicine (pp. 209-222). Philadelphia: WB Saunder.

Schilling, R., & Rylander, R. (1994). Cotton dust. In R. Rylander, & R.R. Jacobs. (Eds.), Organic dust: exposure, effects, and prevention (pp. 177-192).Boca Raton: Lewis Publisher.

Schulte, H.F. (1973). Personal protective devices. . In G.D. Clayton, The industrial environment – its evaluation & control (pp. 519-531). Washington D.C.: U.S. Government Printing Office.

Smith, T.A., & Patton, J. (1999). Health surveillance in milling, baking and other food manufacturing operations-five years' experience. Occup-Med-(Lond). [CD-ROM], 49 (3), pp. 147-153. Abstract from: MEDLINE (R) 1999 Part A. [2001, November 28].

Spencer, H. (1968). Pathology of the lung (Excluding tuberculosis) (2nd ed.). Pergamon: Oxford University Press.

Staub, N.C. (1993). The respiratory system. In R.M.Berne & M.N. Levy (Eds.), Physiology (3rd ed., pp. 547-611). St. Louis: Mosby- Year Book.

Toren, K., Brisman, J., Olin, A.C., & Blanc, P.D. (2000). Asthma on the job: work-related factors in new-onset asthma and in exacerbation of pre-existing asthma. Journal of Respiratory Medicine, 94 (6), 529-535.

Tortora, G.T., & Anagnostakos, N.P. (1984). Principles of anatomy and physiology (4th ed.). New York: Harper & Row.

Van-Kampen, V., Merget, R., & Baur, X. (2000). Occupational airway sensitizers an overview on the respective literature. American Journal of Industrial Medicine, 38(2), 164-218.

Vander, A.J., Sherman, J.H., & Luciano, D.S. (1990). Human physiology: the mechanisms of body function (5th ed.). New York: McGraw- Hill.

Whittenberger, J.L. (1973). Review of physiology. In G.D. Clayton, The industrial environment – its evaluation & control (pp. 51-60). Washington D.C.: U.S. Government Printing Office.

Wiener, R.W., & Rodes, C.E. (1993). Indoor aerosols and aerosol exposure. In K. Willeke, & P.A. Baron, Aerosol measurement principle, techniques, and application, . New York: Van Norstrand Reinhold.

Willeke, K., & Baron, P.A. (1993). Aerosal measurement principle, techniques, and application. New York: Van Nostrand Reinhold.

Wintermeyer, S.F., Kuschner, W.G., Wong, H., D'Alessandro, A., & Blanc, P.D. (1997). Pulmonary response after wood chip mulch exposure. Journal of Occupational and Environmental Medicine, Vol.39(4), 308-314.

World Health Organization. (1997). Determination of airborne fibre number concentration. Geneva: World Health Organization.

World Health Organization. (1996). Users' manual for the IPCs health and safety guides. Stuttgart: Wissenschaftliche Verlagsgesells chaft.

Wright, G.W. (1973). The influence of industrial contaminants on the respiratory system. . In G.D. Clayton, The industrial environment – its evaluation & control (pp. 493-502). Washington D.C.: U.S. Government Printing Office.

Yarbrough, S.S., & Braden, C.J. (2001). Utility of health belief model as a guide for explaining and predicting breast cancer screening behaviors. Journal of Advance Nursing, 33(5), 677-688.

ช่อวิเชียร บริบูรณ์ทรัพย์. (2537). (Cuwichian Borribunetrup, B.E. 2537). ปัจจัยคัดสรรที่มีความสัมพันธ์กับการเกิดโรคบิสซิโนซีสในคนงานโรงงานอุตสาหกรรมสิ่งทอ. วิทยานิพนธ์ปริญญา วิทยาศาสตรมหาบัณฑิต (สาธารณสุขศาสตร์), สาขาวิชาเอกพยาบาลสาธารณสุข บัณฑิตวิทยาลัย มหาวิทยาลัยมหิดล.

นันทวิทย์ บุญเทศ. (2535). (Nuntawit Boondesh, B.E. 2535). ปัจจัยที่มีความสัมพันธ์ต่อการเสื่อมสมรรถภาพปอดของตำรวจจราจรในเขตกรุงเทพมหานคร. วิทยานิพนธ์ปริญญาวิทยาศาสตร์มหาบัณฑิตสาขาวิชาสุขศาสตร์อุตสาหกรรมและความปลอดภัย. บัณฑิตวิทยาลัย มหาวิทยาลัยมหิดล

นพมาศ หริมเทพาธิป. (2542). (Noppamas Hrimthepatip, B.E. 2542). การเสื่อมสมรรถภาพปอดของประชาชนที่อาศัยในพื้นที่ที่มีกิจกรรมการระเบิดและย่อยหิน กรณีศึกษา ตำบลหน้าพระลาน อำเภอเฉลิมพระเกียรติ จังหวัดสระบุรี. วิทยานิพนธ์ปริญญาวิทยาศาสตรมหาบัณฑิต, สาขาเทคโนโลยีการบริหารสิ่งแวดล้อม บัณฑิตวิทยาลัย มหาวิทยาลัยมหิดล.

พรพรรณ วัชรวิทูร. (2542). (Pornpan Watcharavitoon, B.E. 2542). ปัจจัยที่มีความสัมพันธ์กับการเสื่อมสมรรถภาพปอดของคนงานในโรงงานผลิตอาหารสัตว์. วิทยานิพนธ์ปริญญาวิทยาศาสตร์มหาบัณฑิต สาขาวิชาสุขศาสตร์อุตสาหกรรมและความปลอดภัย. บัณฑิตวิทยาลัย มหาวิทยาลัยมหิดล.

วีระศักดิ์ อุดมกิจเลขา. (2542). (Veerasak Udomkijgfcha, B.E. 2542). วิทยาศาสตร์เส้นใย. กรุงเทพฯ: โรงพิมพ์แห่งจุฬาลงกรณ์มหาวิทยาลัย.

ศรีจันทร์ อุทโยภาส. (2536). (Srichant Uthayopas, B.E. 2536). การประเมินความเสี่ยงต่ออนุภาคที่มีผลต่อระบบทางเดินหายใจของคนงานในโรงงานผลิตเบรค-คลัชท์. วิทยานิพนธ์ปริญญาวิทยาศาสตร์มหาบัณฑิต สาขาวิชาสุขศาสตร์อุตสาหกรรมและความปลอดภัย บัณฑิตวิทยาลัย มหาวิทยาลัยมหิดล

สว่าง แสงหิรัญวัฒนา. (2537). (Sawang Saenghirunvattant, B.E. 2537). โรคปอดจากการทำงาน. กรุงเทพฯ: โฮลิชติค พลับลิชชิ่ง.

สุจินดา จารุพัฒน์และคณะ. (2545). (Sujinda Jarupat, B.E. 2545). อัตราชุกและปัจจัยคัดสรรที่มีความสัมพันธ์กับการเกิดโรคปอดฝุ่นฝ้ายในคนงานโรงงานอุตสาหกรรมสิ่งทอขนาดเล็ก. วารสารพยาบาลสาธารณสุข, 16(2), 22-27.

สมเกียรติ วงษ์ทิม. (2542). (Somkiat Wongtim, B.E. 2542). ตำราโรคปอด 1: โรคปอดจากสิ่งแวดล้อม. กรุงเทพฯ: ยูนิตี้ พับลิเคชั่น.

APPENDIX A

APPENDIX A

Consent to Participate in Research Study

Human right for research population

To …………………………………….

I am "Thitiporn Songkroh" a graduate nursing student, Nursing Department, Faculty of Medicine, Ramathibodi Hospital, Mahidol University. I am currently conduct a research about total dust concentration and factors associated with respiratory symptoms among home-based cloth manufacturers in Ayutthaya province. The results of the study will be used to plan for the prevention and reduction of occupational respiratory symptoms of home-based cloth manufacturers in Bansang subdistrict.

You can participate in this study by interview giving a premising to background characteristics, respiratory symptoms, smoking history, occupational preventive actions and measure dust concentration by personal dust sampler. Total time spent in giving instruction and interview is about 30 minutes. You can refuse or participate in this study without any effect on your living and health care used. All data, which you provide will be kept confidentially and used only to present as overall picture.

Thank you for your kind cooperation.

Sincerely yours,

Thitiporn Songkroh

Graduate Nursing Student

APPENDIX B

APPENDIX B
Questionnaire and Data Forms

Part I: Background characteristics data form

1. Name ………………………………………………………
2. Address …………………………………………………….
3. Sex ☐ Male ☐ Female
4. Age ……………………….. (Years old)
5. Years of education …………………… (Years)
6. Monthly income ……………………… (Bath/month)
7. Past respiratory illness: Do you ever be respiratory illness as follow ?

Respiratory illness	Yes	No	Currently symptoms
1.Bronchitis			
2. Altelectalsis			
3.Pulmonary tuberculosis			
4.Asthma			
5.Lung cancer			
6.Pneumonitis			

7.1 Have you been heart disease?

☐ Yes ☐ No

8. Smoking history

8.1 What is your smoking history?

☐ Non-smoker (Skip to 9)

☐ Recent smoker (Skip to 8.4, 8.5 and 9)

☐ Smoker

8.2 How many cigarettes do you smoke a day? (Pieces per day)

8.3 How often do you smoke cigarette?

☐ Everyday ☐ Some day

8.4 How long do you kept away from cigarette smoking? (Years)

8.5 How long do you smoke cigarette? (Years)

9. Occupation

☐ Home-based cloth worker

☐ Government civil

☐ Agriculture

☐ Merchant

☐ Employee

☐ Other ………………………………………………

Part II: Risk factors data form

10. What is your home-based cloth work product?

11. How long do you do home-based cloth work a day? (Hours per day)

12. How many days do you do home-based cloth work a week? (Days per week)

13. How long have you been home-based cloth worker? (Years)

13.1 Do you ever do any occupation?

☐ Yes, what was your occupation?

How long had you done it?

☐ No

Part III: Dust protective action data form

14. Do you use respiratory protective devices during cloth working?

☐ Yes (everyday) ☐ Yes (some day) ☐ No

If your answer is "Yes", what are your respiratory protective devices?

15. Do you clean your workplace and devices after working?

☐ Yes (everyday) ☐ Yes (some day) ☐ No

If your answer is "Yes", what is your cleansing method?

16. Do you separate your working area from living area?

☐ Yes ☐ No

17. Is his/her working area good ventilation?

☐ Yes, what is your ventilated method? ☐ No

18. Do you take the electric fan on during cloth working?

☐ Yes ☐ No

19. Do you take a bath and change your dressing after working?

 Yes No

Part IV : Respiratory symptoms data form

20. Do you cough after waking in the morning?

 Yes No

If your answer is "Yes", do you have a cold while this symptom occurs?

 Yes No

21. Do you cough on your first day of working week?

 Yes No

If your answer is "Yes", do you have a cold while this symptom occurs?

 Yes No

22. Do you have phlegm after waking in the morning?

 Yes No

23. Do you feel chest tightness or breathing difficulty during cloth working?

 Yes No

If your answer is "Yes", do you have a cold while this symptom occurs?

 Yes No

If your answer is "Yes", do you feel chest tightness or breathing difficulty on first cloth working day?

 Yes No

If your answer is "Yes", do you feel chest tightness or breathing difficulty on other cloth working day?

 Yes No

24. Do you have nasal congestion or nasal catarrh during cloth working or after cloth working?

 Yes No Yes with getting a cold.

25. Do you hearing sound of wheezing?

 Yes No Yes with getting a cold.

26. Your parent respiratory illness history (last year)

How many your household members live in your dwelling?

No.	Age	Disease	Past respiratory illness	Frequency (time/last year)	Treatment
1					
2					
3					
4					
5					
6					
7					
8					
9					

APPENDIX C

APPENDIX C
DUST MEASUREMENT METHODS

In this study, dust measurement methods were particle concentration and particle size. Particle concentration is the most commonly measured dust particle quantity that is usually defined as the amount of particulate mass in a unit volume of air. Particle concentration can represent to ability of particle deposition in the human respiratory system (Lehtimaki & Willeke, 1993: 112-113).

However, particle size measurement is of equal importance to particle concentration. The most common of equivalent particle size is the aerodynamic particle diameter that defined as the diameter of spherical unit density, particle with the same gravitational settling velocity as the particle under consideration (Lehtimaki & Willeke, 1993: 113). The definition of equivalent particle size may also on the mobility of the particle in an electric field, the diffusional motion of the particle or any other motion of the particle in an externally applied force field.

Direction of dust sample collection

1. Prepare devices of dust collected including: personal dust sampler, Cassette holder, and filtered paper (Whatman No 41 cellulose)
2. Calibrate sampling pump before using.
3. Put "Whatman No.41 cellulose" which suit the cassette.
4. Connect personal dust sampler and cassette before put it on the sample.
5. Set the dust sampler on lumbar area of sample and set the cassette on collar (near breathing zone of sample).
6. Start collecting dust particles during the sample works and stop collecting when he/she finishes his/her daily cloth working. Total time of collecting is equal duration of daily cloth working. In this study, time duration was represented to 1

hour.

7. Record the time of dust collection.
8. Keep the dust sample (filtered paper) in the box carefully after finishing dust collection.
9. Analyze the dust-collected sample.

Direction of dust particle size measurement

Direction of dust particle size measurement are as follow.

1. Prepare high power microscope.
2. Measure lenge of diameter of nine recticle portions by stage micrometer. This method is called “Project Area Diameter”.
3. Record size of each recticle portions (D_1 to D_9) that is shown in Table 19.
4. Prepare dust slide are as follow.

4.1 Take the filtered paper out from cassette after collection dust.

4.2 Cut the filtered paper to 8 pieces (1 piece = 1 cell).

4.3 Clean the empty slide glass by slide cleansing paper.

4.4 Drop medium solution (1:1 of Dimethyl photalate and Diethyl oxalate) on the cleansing slide and spread it then cover all area of slide (as a size of 1 cell of filtered paper). Don’t drop it so much because dust particle on surface of filtered paper will move away the field.

4.5 Put one cell of filtered paper on the wet slide (stage of 4.4). The surface of dust on cell must be on upper.

4.6 Close the cover slip on the filtered paper cell on slide

4.7 Count a number of dust particle and measure size of dust particle by recticle portion after 15 minutes of stage 4.6

4.8 Record data.

5. Report data.

Size	Field	1	2	3	4	5	6	7	8	9	>10	Total	Cumulative Sum	Cumulative percent
D_1=														
D_2=														
D_3=														
D_4=														
D_5=														
D_6=														
D_7=														
D_8=														
D_9=														
D>10														

Table 19 Dust particle size measurement record

Direction of total dust concentration measurement

Calculate weight of Sample by

$$\text{Total Dust Concentration} = \frac{(W_2 - W_1)}{V} + B \times 10^3 \ (mg/m^3)$$

W_1 = Stable tare weight

W_2 = Sample weight

B = Blank weight

APPENDIX D

APPENDIX D

COLLECTING DATA ILLUSTRATION

Picture 1 GILAIN Personal Dust Sampler

Picture 2. Dust measurement in poor ventilated sport ware manufactory

Picture 3. Dust measurement in good ventilated sport ware manufactory

Picture 4. Dust measurement in good ventilated infant ware manufactory

Picture 5. Dust measurement in poor ventilated infant ware manufactory

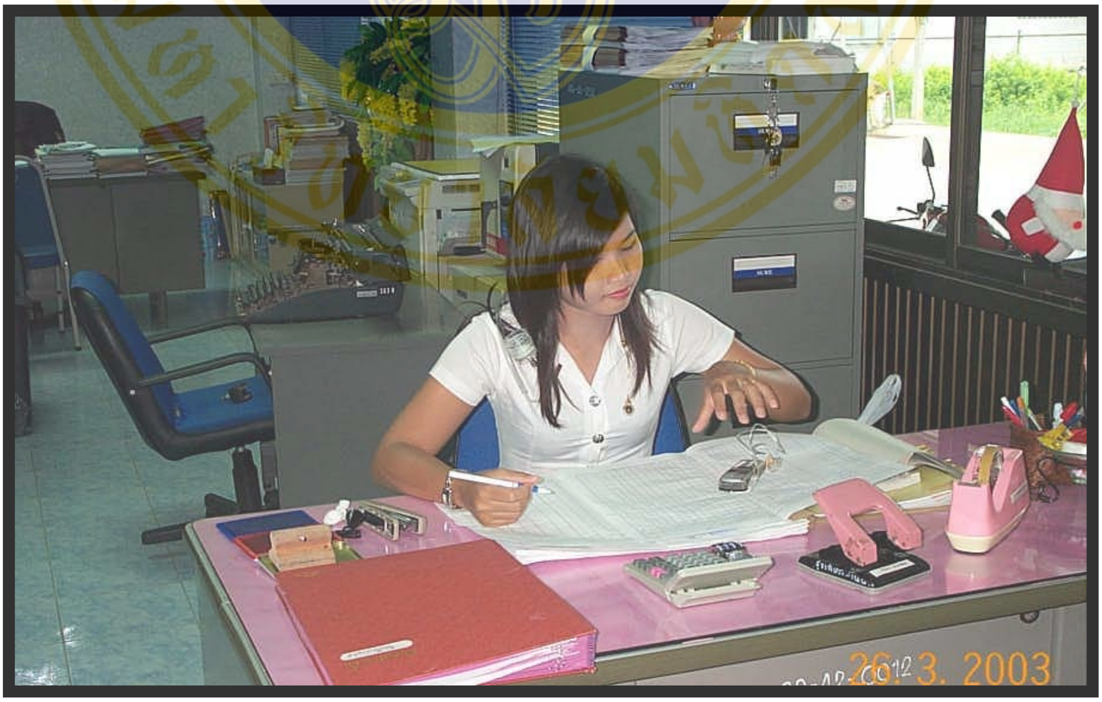
Picture 6. Dust measurement in poorly ventilated cloth rug/woven workplace

Picture 7. Dust measurement in well ventilated cloth rug/woven workplace

Picture 8. Dust measurement in poorly ventilated cloth cutting workplace

Picture 9. Dust measurement in well ventilated cloth cutting workplace

Picture 10. Dust measurement in non-exposure group No.1



Picture 11. Dust measurement in non-exposure group No.2

APPENDIX E

ภาควิชาวิทยาศาสตร์สิ่งแวดล้อม คณะวิทยาศาสตร์ มหาวิทยาลัยศิลปากร
วิทยาเขตพระราชวังสนามจันทร์ อ.เมือง จ. นครปฐม 73000

วิธีการ Calibrate เครื่อง Air Sampling Pump
โดยใช้ Gilibrator 2 VER 4.0

Date: 24/3/03 Location ENVE

Type: Air Sampling Pump : High flow Sample

วิธีการปรับมาตรฐาน

1. เตรียมชุด Calibrate โดยต่อเครื่องเก็บตัวอย่างอากาศเข้ากับ Gilibrator
2. ใส่น้ำสบู่ลงในหน่วยกำเนิดฟอง (Bubble generator unit) ที่เครื่อง Gilibrator
3. ต่อเครื่องเก็บตัวอย่างอากาศเข้ากับ Gilibrator โดยใช้สายยางขนาดพอเหมาะ เอาปลายสายยางข้างหนึ่งสวมเข้ากับท่อดูดอากาศเข้า (Air intake boss)ของเครื่องเก็บตัวอย่างอากาศ ส่วนปลายสายยางอีกข้างหนึ่งนำไปสวมเข้ากับท่ออากาศออก (Outlet boss) ของ Gilibrator
4. เปิดสวิทช์เพื่อเดินเครื่องเก็บตัวอย่างอากาศ
5. กดปุ่มกำเนิดฟองสบู่ ฟองสบู่จะเคลื่อนขึ้นผ่านตัวรับสัญญานตัวล่าง เมื่อฟองสบู่เคลื่อนที่ไปตาม Flow tube จนสุดทางแล้ว อัตราการเคลื่อนที่ของฟองสบู่ เท่ากับอัตราการดูดอากาศของเครื่องเก็บตัวอย่างอากาศ ปรับอัตราการไหลตามต้องการได้ที่ปุ่ม Flow control adjust pod จะปรากฏขึ้นที่จอแสดงผล และพิมพ์ผลออกมาดังที่แสดงข้างล่าง
6. หากต้องการ Calibrate เครื่องอื่น ๆ ก็ทำตามขั้นตอน 3-5

หมายเหตุ ทำการ Calibrate ทุกครั้งก่อนทำการตรวจวัด

Equipment: Calibrator-2

Manufacturer: SENSIDYNE

Model: Primary Flow Calibrator

Serial NO: EC4012-S

GILIBRATOR 2 VER 4.0 Date: 24/3/03

PUMP S/N 10511

FLOW	AVERAGE	#SAMPLES
2000	2000	01

Calibrated by: D. Bchwnd [illegible] Date: 24/3/03

Department of Environmental Science, Faculty of Science, Silpakorn University Nakorn Pathom 73000
Tel. 0066 34 219146 Fax. 0066 34 273047 E-mail : environmentalsu@icqmail.com

ภาควิชาวิทยาศาสตร์สิ่งแวดล้อม คณะวิทยาศาสตร์ มหาวิทยาลัยศิลปากร
วิทยาเขตพระราชวังสนามจันทร์ อ.เมือง จ. นครปฐม 73000

วิธีการ Calibrate เครื่อง Air Sampling Pump
โดยใช้ Gilibrator 2 VER 4.0

Date: 24/3/08 Location: Envi

Type: Air Sampling Pump : High flow Sample

วิธีการปรับมาตรฐาน

1. เตรียมชุด Calibrate โดยต่อเครื่องเก็บตัวอย่างอากาศเข้ากับ Gilibrator
2. ใส่น้ำสบู่ลงในหน่วยกำเนิดฟอง (Bubble generator unit) ที่เครื่อง Gilibrator
3. ต่อเครื่องเก็บตัวอย่างอากาศเข้ากับ Gilibrator โดยใช้สายยางขนาดพอเหมาะ เอาปลายสายยางข้างหนึ่งสวมเข้ากับท่อดูดอากาศเข้า (Air intake boss)ของเครื่องเก็บตัวอย่างอากาศ ส่วนปลายสายยางอีกข้างหนึ่งนำไปสวมเข้ากับท่ออากาศออก (Outlet boss) ของ Gilibrator
4. เปิดสวิทช์เพื่อเดินเครื่องเก็บตัวอย่างอากาศ
5. กดปุ่มกำเนิดฟองสบู่ ฟองสบู่จะเคลื่อนขึ้นผ่านตัวรับสัญญานตัวล่าง เมื่อฟองสบู่เคลื่อนที่ไปตาม Flow tube จนสุดทางแล้ว อัตราการเคลื่อนที่ของฟองสบู่ เท่ากับอัตราการดูดอากาศของเครื่องเก็บตัวอย่างอากาศ ปรับอัตราการไหลตามต้องการได้ที่ปุ่ม Flow control adjust pod จะปรากฏขึ้นที่จอแสดงผล และพิมพ์ผลออกมาดังที่แสดงข้างล่าง
6. หากต้องการ Calibrate เครื่องอื่น ๆ ก็ทำตามขั้นตอน 3-5

หมายเหตุ ทำการ Calibrate ทุกครั้งก่อนทำการตรวจวัด

Equipment: Gilibrator-2

Manufacturer: SENSIDYNE

Model: Primary Flow Calibrator

Serial NO: 2 C4612-S

GILIBRATOR 2 VER 4.0 Date: 24/3/08

PUMP S/N 12510

FLOW	AVERAGE	#SAMPLES
2000	2000	01

Calibrated by: D. Rahman Date: 24/3/08

Department of Environmental Science, Faculty of Science, Silpakorn University Nakorn Pathom 73000
Tel. 0066 34 219146 Fax. 0066 34 273047 E-mail : environmentalsu@lcqmail.com

ภาควิชาวิทยาศาสตร์สิ่งแวดล้อม คณะวิทยาศาสตร์ มหาวิทยาลัยศิลปากร
วิทยาเขตพระราชวังสนามจันทร์ อ.เมือง จ. นครปฐม 73000

วิธีการ Calibrate เครื่อง Air Sampling Pump
โดยใช้ Gilibrator 2 VER 4.0

Date: 24/3/03 Location: ENVE

Type: Air Sampling Pump : High flow Sample

วิธีการปรับมาตรฐาน

1. เตรียมชุด Calibrate โดยต่อเครื่องเก็บตัวอย่างอากาศเข้ากับ Gilibrator
2. ใส่น้ำสบู่ลงในหน่วยกำเนิดฟอง (Bubble generator unit) ที่เครื่อง Gilibrator
3. ต่อเครื่องเก็บตัวอย่างอากาศเข้ากับ Gilibrator โดยใช้สายยางขนาดพอเหมาะ เอาปลายสายยางข้างหนึ่งสวมเข้ากับท่อดูดอากาศเข้า (Air intake boss)ของเครื่องเก็บตัวอย่างอากาศ ส่วนปลายสายยางอีกข้างหนึ่งนำไปสวมเข้ากับท่ออากาศออก (Outlet boss) ของ Gilibrator
4. เปิดสวิทซ์เพื่อเดินเครื่องเก็บตัวอย่างอากาศ
5. กดปุ่มกำเนิดฟองสบู่ ฟองสบู่จะเคลื่อนขึ้นผ่านตัวรับสัญญานตัวล่าง เมื่อฟองสบู่เคลื่อนที่ไปตาม Flow tube จนสุดทางแล้ว อัตราการเคลื่อนที่ของฟองสบู่ เท่ากับอัตราการดูดอากาศของเครื่องเก็บตัวอย่างอากาศ ปรับอัตราการไหลตามต้องการได้ที่ปุ่ม Flow control adjust pod จะปรากฏขึ้นที่จอแสดงผล และพิมพ์ผลออกมาดังที่แสดงข้างล่าง
6. หากต้องการ Calibrate เครื่องอื่น ๆ ก็ทำตามขั้นตอน 3-5

หมายเหตุ ทำการ Calibrate ทุกครั้งก่อนทำการตรวจวัด

Equipment: Calibrator -2
Manufacturer: SENSIDYNE
Model: Primary flow Calibrator
Serial NO: E04012 -S
GILIBRATOR 2 VER 4.0 Date: 24/3/03
PUMP S/N 10512

FLOW	AVERAGE	#SAMPLES
2000	2000	04

Calibrated by: D. Bhuwath Date 24/3/03

Department of Environmental Science, Faculty of Science, Silpakorn University Nakorn Pathom 73000
Tel. 0066 34 219146 Fax. 0066 34 273047 E-mail : environmentalsu@lcgmail.com

ภาควิชาวิทยาศาสตร์สิ่งแวดล้อม คณะวิทยาศาสตร์ มหาวิทยาลัยศิลปากร
วิทยาเขตพระราชวังสนามจันทร์ อ.เมือง จ. นครปฐม 73000

วิธีการ Calibrate เครื่อง Air Sampling Pump
โดยใช้ Gilibrator 2 VER 4.0

Date: 24/3/03 Location ENVE

Type: Air Sampling Pump : High flow Sample

วิธีการปรับมาตรฐาน

1. เตรียมชุด Calibrate โดยต่อเครื่องเก็บตัวอย่างอากาศเข้ากับ Gilibrator
2. ใส่น้ำสบู่ลงในหน่วยกำเนิดฟอง (Bubble generator unit) ที่เครื่อง Gilibrator
3. ต่อเครื่องเก็บตัวอย่างอากาศเข้ากับ Gilibrator โดยใช้สายยางขนาดพอเหมาะ เอาปลายสายยางข้างหนึ่งสวมเข้ากับท่อดูดอากาศเข้า (Air intake boss)ของเครื่องเก็บตัวอย่างอากาศ ส่วนปลายสายยางอีกข้างหนึ่งนำไปสวมเข้ากับท่ออากาศออก (Outlet boss) ของ Gilibrator
4. เปิดสวิทซ์เพื่อเดินเครื่องเก็บตัวอย่างอากาศ
5. กดปุ่มกำเนิดฟองสบู่ ฟองสบู่จะเคลื่อนขึ้นผ่านตัวรับสัญญานตัวล่าง เมื่อฟองสบู่เคลื่อนที่ไปตาม Flow tube จนสุดทางแล้ว อัตราการเคลื่อนที่ของฟองสบู่ เท่ากับอัตราการดูดอากาศของเครื่องเก็บตัวอย่างอากาศ ปรับอัตราการไหลตามต้องการได้ที่ปุ่ม Flow control adjust pod จะปรากฏขึ้นที่จอแสดงผล และพิมพ์ผลออกมาดังที่แสดงข้างล่าง
6. หากต้องการ Calibrate เครื่องอื่น ๆ ก็ทำตามขั้นตอน 3-5

หมายเหตุ ทำการ Calibrate ทุกครั้งก่อนทำการตรวจวัด

Equipment: Gilibrator-2

Manufacturer: SENSIDYNE

Model: Primary Flow Calibrator

Serial NO: 800012-S

GILIBRATOR 2 VER 4.0 Date: 24/3/03

PUMP S/N 12K14

FLOW	AVERAGE	#SAMPLES
2000	2000	

Calibrated by: D. Phuwisan Date: 24/3/03

Department of Environmental Science, Faculty of Science, Silpakorn University Nakom Pathom 73000
Tel. 0066 34 219146 Fax. 0066 34 273047 E-mail : environmentalsu@icqmail.com

ภาควิชาวิทยาศาสตร์สิ่งแวดล้อม คณะวิทยาศาสตร์ มหาวิทยาลัยศิลปากร
วิทยาเขตพระราชวังสนามจันทร์ อ.เมือง จ. นครปฐม 73000

วิธีการ Calibrate เครื่อง Air Sampling Pump
โดยใช้ Gilibrator 2 VER 4.0

Date: 24/3/03 Location: ENVE

Type: Air Sampling Pump : High flow Sample

วิธีการปรับมาตรฐาน

1. เตรียมชุด Calibrate โดยต่อเครื่องเก็บตัวอย่างอากาศเข้ากับ Gilibrator
2. ใส่น้ำสบู่ลงในหน่วยกำเนิดฟอง (Bubble generator unit) ที่เครื่อง Gilibrator
3. ต่อเครื่องเก็บตัวอย่างอากาศเข้ากับ Gilibrator โดยใช้สายยางขนาดพอเหมาะ เอาปลายสายยางข้างหนึ่งสวมเข้ากับท่อดูดอากาศเข้า (Air intake boss)ของเครื่องเก็บตัวอย่างอากาศ ส่วนปลายสายยางอีกข้างหนึ่งนำไปสวมเข้ากับท่ออากาศออก (Outlet boss) ของ Gilibrator
4. เปิดสวิทช์เพื่อเดินเครื่องเก็บตัวอย่างอากาศ
5. กดปุ่มกำเนิดฟองสบู่ ฟองสบู่จะเคลื่อนขึ้นผ่านตัวรับสัญญานตัวล่าง เมื่อฟองสบู่เคลื่อนที่ไปตาม Flow tube จนสุดทางแล้ว อัตราการเคลื่อนที่ของฟองสบู่ เท่ากับอัตราการดูดอากาศของเครื่องเก็บตัวอย่างอากาศ ปรับอัตราการไหลตามต้องการได้ที่ปุ่ม Flow control adjust pod จะปรากฏขึ้นที่จอแสดงผล และพิมพ์ผลออกมาดังที่แสดงข้างล่าง
6. หากต้องการ Calibrate เครื่องอื่น ๆ ก็ทำตามขั้นตอน 3-5

หมายเหตุ ทำการ Calibrate ทุกครั้งก่อนทำการตรวจวัด

Equipment: Calibrator - 2

Manufacturer: SENSIDYNE

Model: Primary Flow Calibrator

Serial NO: 8CA012-S

GILIBRATOR 2 VER 4.0 Date: 24/3/03

PUMP S/N 12 ท/3

FLOW	AVERAGE	#SAMPLES
2000	2000	01

Calibrated by: D. Bhunesh Date: 24/3/03

Department of Environmental Science, Faculty of Science, Silpakorn University Nakorn Pathom 73000
Tel. 0066 34 219146 Fax. 0066 34 273047 E-mail : environmentalsu@icqmail.com

ภาควิชาวิทยาศาสตร์สิ่งแวดล้อม คณะวิทยาศาสตร์ มหาวิทยาลัยศิลปากร
วิทยาเขตพระราชวังสนามจันทร์ อ.เมือง จ. นครปฐม 73000

วิธีการ Calibrate เครื่อง Air Sampling Pump
โดยใช้ Gilibrator 2 VER 4.0

Date: 24/3/03 Location ENVI

Type: Air Sampling Pump : High flow Sample

วิธีการปรับมาตรฐาน

1. เตรียมชุด Calibrate โดยต่อเครื่องเก็บตัวอย่างอากาศเข้ากับ Gilibrator
2. ใส่น้ำสบู่ลงในหน่วยกำเนิดฟอง (Bubble generator unit) ที่เครื่อง Gilibrator
3. ต่อเครื่องเก็บตัวอย่างอากาศเข้ากับ Gilibrator โดยใช้สายยางขนาดพอเหมาะ เอาปลายสายยางข้างหนึ่งสวมเข้ากับท่อดูด อากาศเข้า (Air intake boss)ของเครื่องเก็บตัวอย่างอากาศ ส่วนปลายสายยางอีกข้างหนึ่งนำไปสวมเข้ากับท่ออากาศออก (Outlet boss) ของ Gilibrator
4. เปิดสวิทช์เพื่อเดินเครื่องเก็บตัวอย่างอากาศ
5. กดปุ่มกำเนิดฟองสบู่ ฟองสบู่จะเคลื่อนขึ้นผ่านตัวรับสัญญานตัวล่าง เมื่อฟองสบู่เคลื่อนที่ไปตาม Flow tube จนสุดทางแล้ว อัตราการเคลื่อนที่ของฟองสบู่ เท่ากับอัตราการดูดอากาศของเครื่องเก็บตัวอย่างอากาศ ปรับอัตราการไหลตามต้องการได้ที่ปุ่ม Flow control adjust pod จะปรากฏขึ้นที่จอแสดงผล และพิมพ์ผลออกมาดังที่แสดงข้างล่าง
6. หากต้องการ Calibrate เครื่องอื่น ๆ ก็ทำตามขั้นตอน 3-5

หมายเหตุ ทำการ Calibrate ทุกครั้งก่อนทำการตรวจวัด

Equipment: Gilibrator-2

Manufacturer: SENSIDYNE

Model: Primary flow Galibrator

Serial NO: 804012-S

GILIBRATOR 2 VER 4.0 Date: 24/8/03

PUMP S/N 12517

FLOW	AVERAGE	#SAMPLES
2000	2000	01

Calibrated by: D. Bohwech Date: 24/03/03

Department of Environmental Science, Faculty of Science, Silpakorn University Nakorn Pathom 73000
Tel. 0066 34 219146 Fax. 0066 34 273047 E-mail : environmentalsu@icqmail.com

ภาควิชาวิทยาศาสตร์สิ่งแวดล้อม คณะวิทยาศาสตร์ มหาวิทยาลัยศิลปากร
วิทยาเขตพระราชวังสนามจันทร์ อ.เมือง จ. นครปฐม 73000

วิธีการ Calibrate เครื่อง Air Sampling Pump
โดยใช้ Gilibrator 2 VER 4.0

ate: 24/3/03 Location ENVS

e: Air Sampling Pump : High flow Sample

ารปรับมาตรฐาน

1. เตรียมชุด Calibrate โดยต่อเครื่องเก็บตัวอย่างอากาศเข้ากับ Gilibrator
2. ใส่น้ำสบู่ลงในหน่วยกำเนิดฟอง (Bubble generator unit) ที่เครื่อง Gilibrator
3. ต่อเครื่องเก็บตัวอย่างอากาศเข้ากับ Gilibrator โดยใช้สายยางขนาดพอเหมาะ เอาปลายสายยางข้างหนึ่งสวมเข้ากับท่ อากาศเข้า (Air intake boss)ของเครื่องเก็บตัวอย่างอากาศ ส่วนปลายสายยางอีกข้างหนึ่งนำไปสวมเข้ากับท่ออากาศ (Outlet boss) ของ Gilibrator
4. เปิดสวิทซ์เพื่อเดินเครื่องเก็บตัวอย่างอากาศ
5. กดปุ่มกำเนิดฟองสบู่ ฟองสบู่จะเคลื่อนขึ้นผ่านตัวรับสัญญานตัวล่าง เมื่อฟองสบู่เคลื่อนที่ไปตาม Flow tube จนสุดทาง อัตราการเคลื่อนที่ของฟองสบู่ เท่ากับอัตราการดูดอากาศของเครื่องเก็บตัวอย่างอากาศ ปรับอัตราการไหลตามต้องการได้ Flow control adjust pod จะปรากฏขึ้นที่จอแสดงผล และพิมพ์ผลออกมาดังที่แสดงข้างล่าง
6. หากต้องการ Calibrate เครื่องอื่น ๆ ก็ทำตามขั้นตอน 3-5

มายเหตุ ทำการ Calibrate ทุกครั้งก่อนทำการตรวจวัด

uipment: Galibrator - 2

ıufacturer: SENSIDYNE

del: Primary Flow Calibrator

ial NO: 804012 - S

IBRATOR 2 VER 4.0 Date: 24/3/03

MP S/N 12516

)W	AVERAGE	#SAMPLES
0	2000	01

ibrated by: T. Pehuwech Date 24/3/03

Department of Environmental Science, Faculty of Science, Silpakorn University Nakorn Pathom 73000
Tel. 0066 34 219146 Fax. 0066 34 273047 E-mail : environmentalsu@icqmail.com

ภาควิชาวิทยาศาสตร์สิ่งแวดล้อม คณะวิทยาศาสตร์ มหาวิทยาลัยศิลปากร
วิทยาเขตพระราชวังสนามจันทร์ อ.เมือง จ. นครปฐม 73000

วิธีการ Calibrate เครื่อง Air Sampling Pump
โดยใช้ Gilibrator 2 VER 4.0

e: 24/3/03 Location ENVC

: Air Sampling Pump : High flow Sample

รปรับมาตรฐาน

1. เตรียมชุด Calibrate โดยต่อเครื่องเก็บตัวอย่างอากาศเข้ากับ Gilibrator
2. ใส่น้ำสบู่ลงในหน่วยกำเนิดฟอง (Bubble generator unit) ที่เครื่อง Gilibrator
3. ต่อเครื่องเก็บตัวอย่างอากาศเข้ากับ Gilibrator โดยใช้สายยางขนาดพอเหมาะ เอาปลายสายยางข้างหนึ่งสวมเข้ากับท่อ อากาศเข้า (Air intake boss)ของเครื่องเก็บตัวอย่างอากาศ ส่วนปลายสายยางอีกข้างหนึ่งนำไปสวมเข้ากับท่ออากาศอ (Outlet boss) ของ Gilibrator
4. เปิดสวิทซ์เพื่อเดินเครื่องเก็บตัวอย่างอากาศ
5. กดปุ่มกำเนิดฟองสบู่ ฟองสบู่จะเคลื่อนขึ้นผ่านตัวรับสัญญานตัวล่าง เมื่อฟองสบู่เคลื่อนที่ไปตาม Flow tube จนสุดทางแ อัตราการเคลื่อนที่ของฟองสบู่ เท่ากับอัตราการดูดอากาศของเครื่องเก็บตัวอย่างอากาศ ปรับอัตราการไหลตามต้องการได้ที่ Flow control adjust pod จะปรากฏขึ้นที่จอแสดงผล และพิมพ์ผลออกมาดังที่แสดงข้างล่าง
6. หากต้องการ Calibrate เครื่องอื่น ๆ ก็ทำตามขั้นตอน 3-5

ายเหตุ ทำการ Calibrate ทุกครั้งก่อนทำการตรวจวัด

ipment: Galibrator-2
ufacturer: SENSIDYNE
el: Primary flow Calibrator
l NO: 804012 S
BRATOR 2 VER 4.0 Date: 24/3/03
P S/N 12517

W	AVERAGE	#SAMPLES
)	2000	01

orated by: D. Khonech Date: 24/3/03

Department of Environmental Science, Faculty of Science, Silpakorn University Nakorn Pathom 73000
Tel. 0066 34 219146 Fax. 0066 34 273047 E-mail : environmentalsu@icqmail.com

ภาควิชาวิทยาศาสตร์สิ่งแวดล้อม คณะวิทยาศาสตร์ มหาวิทยาลัยศิลปากร
วิทยาเขตพระราชวังสนามจันทร์ อ.เมือง จ. นครปฐม 73000

วิธีการ Calibrate เครื่อง Air Sampling Pump
โดยใช้ Gilibrator 2 VER 4.0

e: 24/3/03 Location ENVT

Air Sampling Pump : High flow Sample

ปรับมาตรฐาน

1. เตรียมชุด Calibrate โดยต่อเครื่องเก็บตัวอย่างอากาศเข้ากับ Gilibrator
2. ใส่น้ำสบู่ลงในหน่วยกำเนิดฟอง (Bubble generator unit) ที่เครื่อง Gilibrator
3. ต่อเครื่องเก็บตัวอย่างอากาศเข้ากับ Gilibrator โดยใช้สายยางขนาดพอเหมาะ เอาปลายสายยางข้างหนึ่งสวมเข้ากับท่อดู อากาศเข้า (Air intake boss)ของเครื่องเก็บตัวอย่างอากาศ ส่วนปลายสายยางอีกข้างหนึ่งนำไปสวมเข้ากับท่ออากาศอ (Outlet boss) ของ Gilibrator
4. เปิดสวิทซ์เพื่อเดินเครื่องเก็บตัวอย่างอากาศ
5. กดปุ่มกำเนิดฟองสบู่ ฟองสบู่จะเคลื่อนขึ้นผ่านตัวรับสัญญานตัวล่าง เมื่อฟองสบู่เคลื่อนที่ไปตาม Flow tube จนสุดทางแ อัตราการเคลื่อนที่ของฟองสบู่ เท่ากับอัตราการดูดอากาศของเครื่องเก็บตัวอย่างอากาศ ปรับอัตราการไหลตามต้องการได้ที่ Flow control adjust pod จะปรากฏขึ้นที่จอแสดงผล และพิมพ์ผลออกมาดังที่แสดงข้างล่าง
6. หากต้องการ Calibrate เครื่องอื่น ๆ ก็ทำตามขั้นตอน 3-5

ายเหตุ ทำการ Calibrate ทุกครั้งก่อนทำการตรวจวัด

pment: Galibator-2

ıfacturer: SENSIDYNE

el: Primary Flow Calibrator

l NO: 804012-S

BRATOR 2 VER 4.0 Date: 24/3/03

P S/N 12518

N	AVERAGE	#SAMPLES
	2000	01

rated by: D. Bohumeh Date: 24/3/03

Department of Environmental Science, Faculty of Science, Silpakorn University Nakorn Pathom 73000
Tel. 0066 34 219146 Fax. 0066 34 273047 E-mail : environmentalsu@icqmail.com

ภาควิชาวิทยาศาสตร์สิ่งแวดล้อม คณะวิทยาศาสตร์ มหาวิทยาลัยศิลปากร
วิทยาเขตพระราชวังสนามจันทร์ อ.เมือง จ. นครปฐม 73000

วิธีการ Calibrate เครื่อง Air Sampling Pump
โดยใช้ Gilibrator 2 VER 4.0

ate: 24/3/03 Location ENVI

e: Air Sampling Pump : High flow Sample

ารปรับมาตรฐาน

1. เตรียมชุด Calibrate โดยต่อเครื่องเก็บตัวอย่างอากาศเข้ากับ Gilibrator
2. ใส่น้ำสบู่ลงในหน่วยกำเนิดฟอง (Bubble generator unit) ที่เครื่อง Gilibrator
3. ต่อเครื่องเก็บตัวอย่างอากาศเข้ากับ Gilibrator โดยใช้สายยางขนาดพอเหมาะ เอาปลายสายยางข้างหนึ่งสวมเข้ากับท่อ อากาศเข้า (Air intake boss)ของเครื่องเก็บตัวอย่างอากาศ ส่วนปลายสายยางอีกข้างหนึ่งนำไปสวมเข้ากับท่ออากาศ (Outlet boss) ของ Gilibrator
4. เปิดสวิทซ์เพื่อเดินเครื่องเก็บตัวอย่างอากาศ
5. กดปุ่มกำเนิดฟองสบู่ ฟองสบู่จะเคลื่อนขึ้นผ่านตัวรับสัญญานตัวล่าง เมื่อฟองสบู่เคลื่อนที่ไปตาม Flow tube จนสุดทาง อัตราการเคลื่อนที่ของฟองสบู่ เท่ากับอัตราการดูดอากาศของเครื่องเก็บตัวอย่างอากาศ ปรับอัตราการไหลตามต้องการได้ที่ Flow control adjust pod จะปรากฏขึ้นที่จอแสดงผล และพิมพ์ผลออกมาดังที่แสดงข้างล่าง
6. หากต้องการ Calibrate เครื่องอื่น ๆ ก็ทำตามขั้นตอน 3-5

มายเหตุ ทำการ Calibrate ทุกครั้งก่อนทำการตรวจวัด

uipment: Galibator – 2

nufacturer: SENSIDYNE

del: Primary flow Galibrator

ial NO: 804012 –S

IBRATOR 2 VER 4.0 Date: 24/03/03

MP S/N 12519

OW	AVERAGE	#SAMPLES
00	2000	

librated by: D. Bohuweck Date: 24/03/03

Department of Environmental Science, Faculty of Science, Silpakorn University Nakorn Pathom 73000
Tel. 0066 34 219146 Fax. 0066 34 273047 E-mail : environmentalsu@lcqmail.com

ภาควิชาวิทยาศาสตร์สิ่งแวดล้อม คณะวิทยาศาสตร์ มหาวิทยาลัยศิลปากร
วิทยาเขตพระราชวังสนามจันทร์ อ.เมือง จ. นครปฐม 73000

วิธีการ Calibrate เครื่อง Air Sampling Pump
โดยใช้ Gilibrator 2 VER 4.0

ate: 24/3/03 Location ENVI

e: Air Sampling Pump : High flow Sample

ารปรับมาตรฐาน

1. เตรียมชุด Calibrate โดยต่อเครื่องเก็บตัวอย่างอากาศเข้ากับ Gilibrator
2. ใส่น้ำสบู่ลงในหน่วยกำเนิดฟอง (Bubble generator unit) ที่เครื่อง Gilibrator
3. ต่อเครื่องเก็บตัวอย่างอากาศเข้ากับ Gilibrator โดยใช้สายยางขนาดพอเหมาะ เอาปลายสายยางข้างหนึ่งสวมเข้ากับท่อ อากาศเข้า (Air intake boss)ของเครื่องเก็บตัวอย่างอากาศ ส่วนปลายสายยางอีกข้างหนึ่งนำไปสวมเข้ากับท่ออากาศอ (Outlet boss) ของ Gilibrator
4. เปิดสวิทซ์เพื่อเดินเครื่องเก็บตัวอย่างอากาศ
5. กดปุ่มกำเนิดฟองสบู่ ฟองสบู่จะเคลื่อนขึ้นผ่านตัวรับสัญญานตัวล่าง เมื่อฟองสบู่เคลื่อนที่ไปตาม Flow tube จนสุดทางแ อัตราการเคลื่อนที่ของฟองสบู่ เท่ากับอัตราการดูดอากาศของเครื่องเก็บตัวอย่างอากาศ ปรับอัตราการไหลตามต้องการได้ที่ Flow control adjust pod จะปรากฏขึ้นที่จอแสดงผล และพิมพ์ผลออกมาดังที่แสดงข้างล่าง
6. หากต้องการ Calibrate เครื่องอื่น ๆ ก็ทำตามขั้นตอน 3-5

มายเหตุ ทำการ Calibrate ทุกครั้งก่อนทำการตรวจวัด

uipment: Galibrator -2

ıufacturer: SENSIDYNE

del: Primary flow Calibrator

ial NO: 804012 -S

IBRATOR 2 VER 4.0 Date: 24/03/03

MP S/N 12519

)W	AVERAGE	#SAMPLES
0	2000	01

ibrated by: D. Bohoresh Date: 24/03/03

Department of Environmental Science, Faculty of Science, Silpakorn University Nakorn Pathom 73000
Tel. 0066 34 219146 Fax. 0066 34 273047 E-mail : environmentalsu@icqmail.com

BIOGRAPHY

NAME Miss Thitiporn Songkroh

DATE OF BIRTH 22 June 1969

PLACE OF BIRTH Ayuttaya, Thailand

INSTITUTIONS ATTENDED Chonburi Nursing College,

1987-1991: Diploma in Nursing Science

Equivalent to Bachelor of Science in Nursing

Mahidol University, 2000-2003:

Master of Nursing Science

(Community Health Nursing)

OFFICE & POSITION 1991- Present:

Sena Hospital,

Ayutthaya Province, Thailand

Position: Registered Nurse