CHAPTER 1

INTRODUCTION

1.1 Introduction

Manufacturers from various industry segments have discovered carbon dioxide snow cleaning technology as a reliable, consistently effective, easy-to-use, and economical method of cleaning parts. In applications where both precise cleanliness and production objectives must be achieved, this cleaning technique provides significant environmental benefits over other more conventional alternatives.

Primary elements, such as concern for the environment, economic competitiveness, an technology, have converged recently to cause both industry and government to reassess the cleaning phase of manufacturing processes.

Widespread changes have been implemented, with trends moving towards zero discharge of pollutants into the air, water, and soil. Many manufactures of industrial and commercial products have been directly affected by phase-outs and regulations influencing many chemistries, especially ozone-depleting compounds (ODCs).

Companies world-wide are facing new challenges brought by implementing replacement processes in the wake of those deemed environmentally hazardous. New processes have created new dilemmas: rinsing and drying issues, equipment and bath maintenance, rust and corrosion, chemical disposal, and new environment restrictions to name a few. In addition, many replacement technologies, including alternative solvents and some aqueous formulations, themselves have uncertain regulatory futures.

Carbon dioxide (CO_2) snow cleaning is, for some manufactures, a prominent entry on their list of viable alternatives to current ODC-based operations. Over the past several years, there has been considerable investigation into the effectiveness of the technology. Users in several high-tech markets are taking advantage of the unique surface cleaning capabilities of CO_2 snow to improve to existing cleaning standards. In fact, progressive design improvement and process optimizations have earned this relatively new cleaning method a position on the production line of some major micro device manufactures world-wide. This article explores the science of snow cleaning and offers some case reports based on a patented CO_2 snow cleaning technology, which uses a thermally ionized gas (TIG) snow-or TIG-snow.

There are 2 concerning items that we have to find out the problem solution:

[1] Part cleanliness Problem. It is the trigger to our initially idea that made us to analyze this problem. Currently, we have cleaned part by wiping with cloth and found out the incomplete and ineffective cleaning. The good cleaning depends on operator that made us unable to control the overall part cleanliness.

[2] Cleaning Productivity Improvement. We consider the Tact Time of CO_2 cleaning must allow us to achieve more productivity. So, the total cost of CO_2 cleaning is more interest to study.

From the reason above, it has a good idea why don't we implement Carbon Dioxide Snow Cleaning for Hard Disk Drive (HDD) component by considering part cleanliness and cleaning productivity. The first think that we have to experiment what is strong and weak point, and then we come up with the implement schedule.

We aim to implement Carbon Dioxide Snow Cleaning in company as soon as possible, because the part cleanliness quality problem can be seriously caused HDDmalfunction. Other than that benefit, we can transfer know-how to Thai technical skill labor in order to improve their workability.

1.2 Rationale of the Study

This thesis should be more valuable study and applicable for my company: IBM Storage Products (Thailand) Limited, because there is very slightly Electronic company is recognized to implement Carbon Dioxide Snow Cleaning with providing more technical of cleaning process using solid carbon dioxide propelled in a high velocity air jet. No publications are stated about to clean HDD part. The strength and weakness must be deliberated in academic aspect. The result from this thesis should give the tangible idea to concerned person who are working in field of cleaning engineering and want to get this information for improving their working organization more effectively and efficiently.

Referring to Cleaning with CO_2 and Dry Ice Particles [1] : Any time air or water blows across a surface, the fluid at the surface will be -- except at its outer most edge, where the fluid meets the air--at rest. Because this area, called the boundary layer, is some microns thick, any 0.1 to 2 micron particles will be left on the surface by molecular attraction, it is difficult to remove them. Washing with liquid cleaners or using a technology such as Megasonics can certainly help, but in many cases, liquid cleaners or Megasonics cannot be used because no fluid can ever really the surface. This may be time for dry ice or CO_2

1 Advancing Applications in Contamination Control, Cleaning with CO_2 and Dry Ice Particles, March 2002, (p7-10).

Secondly, if this project is successful, we can contribute to company to improve the part cleanliness. This is because the effectiveness of CO_2 gives the best result more than traditional cleaning. Finally, this study will be used to be a reference standard all of aspect that we can see significantly different the cleaning process improvement. See figure 1 for more understanding about Carbon Dioxide Snow Cleaning

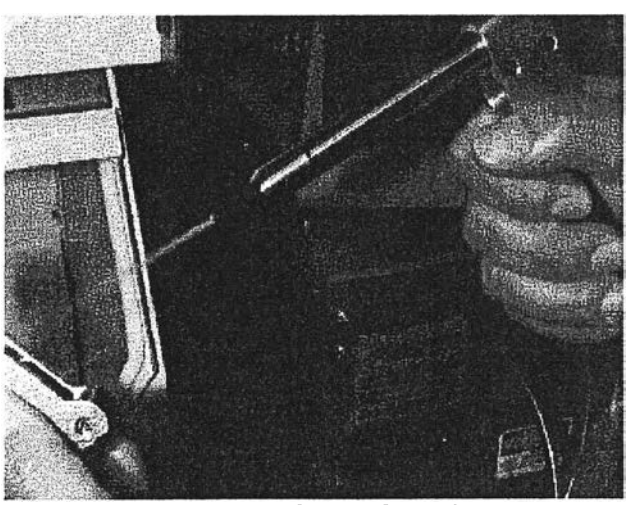

Figure 1 illustrated Carbon Dioxide Snow Cleaning
Source : IBM research and development

1.3 Background of Reworked Parts Cleaning in HDD

Currently, the most company has cleaned the reworked by using wiper (cloth) with Isopropyl Alcohol (IPA) or De-ionized water (DI water). The result after cleaning some parts is showed the residue contamination still remains on the surface. This will lead to part contamination problem. So, the scrap cost unit is increased over target. The purpose of parts cleaning are described as follows;

Particles are attached to the surface by Contamination, Physical link, Static, Force and Gravity. Removing particles generally requires mechanical means Turbulent agitation, Flow, Ultrasonic cavitation or streaming and Spray typically in a 'wet' environment Frequently with some chemistry.

Why we want to implement CO_2 cleaning. Cleaning process using solid carbon dioxide propelled in a high velocity air jet used to remove particulate from surfaces

The following table 1 is advantages and disadvantages of Carbon Dioxide cleaning.

No	*Advantages*	*Disadvantages*
1	Non-Aqueous-Safe for Parts that cannot tolerate water	Piece part process (Tray I/O but not batch cleaning)
2	No Residue- CO_2 is only gas at 1 ATM/room temp.	Requires CO_2 supply - messier than conventional services
3	No drying problem	Uses industrial CO_2 tanks-dirty so must be removed
4	Fast time for cleaning	Robot must be made safe- manageable risk
5	Low cost	

Table 1 illustrated advantages and disadvantages of Carbon Dioxide
Source : Cleaning Engineering, Carbon Dioxide snow cleaning, IBM.

How CO2 cleaner work

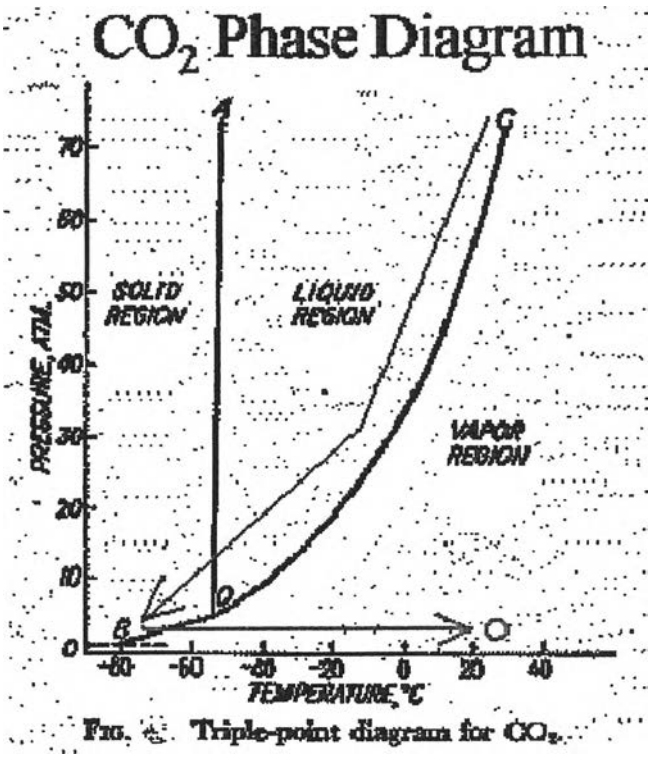

Figure 2 illustrated Triple-point diagram for CO_2
Source : IBM research and development

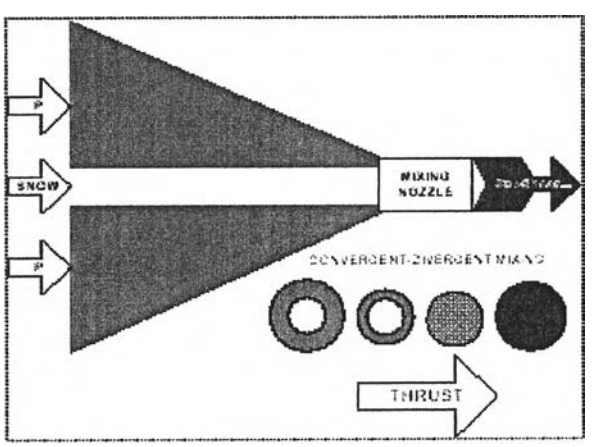

Figure 3 illustrated Mixing Nozzle Diagram
Source : IBM research and development

1.4 Problem Cause Analysis

We have experienced the contamination problem from cleaning process on my job assignment. The best solution is we have to develop new cleaning method to remove the micro-contamination on the surface of parts. Therefore, all problem aspect can be summarized as follows,

[1] Return On Investment (ROI) decision making.
[2] Supportive reference technical from another industry and abstract.
[3] Lack of knowledge how to implement CO_2 cleaning.
[4] Part cleanliness problem.
[5] Scrap part Reduction.

We made completely to considerable problem above, then we can get understanding to make an excellent master plan for maximizing benefit from this project.

The reworked parts are strongly required to increase the part cleanliness level in every day. That means we have to find out the new method to catch up that requirement. Other than that, the new method is implemented should be effective cleaning, fast working and low cost. From historical record of failure HDD, one of the problem came from contamination problem. Resulting from this we still the product quality problem.

The purpose of study is to identify appropriate Carbon Dioxide cleaning conditions to HDD reworked parts in company. This study is to provide the real information and tangible approach to concerned group who are working in the field of part cleaning.

The scope of the study of appropriate CO_2 cleaner conditions is as follows,
Design and Analysis of Experiments
Factorial designs are applied for this CO_2 cleaner implementation. The factors are influence for CO2 cleaner implementation as follows:

1. Completed Dry Air Heater Temp.(C)	80 (min) - 120 (max)
2. Pressure (PSI) setting	650 (min) - 950 (max)
3. CO2 amount setting	0.1(min) - 1 (max)
4. Distance of CO2 nozzle (Inch)	0.5(min) - 2 (max)

1.5 Expected Results

There are three expected results that we can make continuous improvement to meet company objective. They can be summarised as below,

- To be used for guide line to identify an appropriate CO_2 cleaning conditions.
- Part cleanliness improvement.
- CO_2 cleaner implementation can be used to be reference for partner company.

1.6 Profit contributing to company

This thesis study has much to contribute to company in terms of quality improvement, cleaning productivity and technical knowledge enhancement. Table 2 illustrates before and after implementation CO_2 cleaner that may accrue to upper management for taking consideration and decision making.

Comparison of current cleaning and CO_2 cleaning profitability	
Current cleaning	**CO_2 cleaner**
Incomplete remove contamination	Cleanliness improvement
Chemical hazard	No drying problem
More consumption time in Cleaning process	Fast time for cleaning
Non Aqueous unsafe for parts can't tolerate water.	Non-aqueous- safe for parts can't tolerate water.
Drying problem	

Table 2 Comparison of current cleaning and CO_2 cleaning profitability.

1.7 Methodology

To obtain of this study, the following are described step by step of the methodology.

[1] Study in actual working at cleaning process, text book, Internet, technical report.
[2] Collect data and study cleaning procedure.
[3] Consider the Pros and Cons in case we implement CO_2 cleaner.
[4] Study work instruction each cleaning process and part cleanliness analysis.
[5] Collect data from outside company, inquiry to in charge person in order to make possibility plan and conduct experiment to identify appropriate CO_2 cleaning conditions.
[6] Analyze all information and data collection for final conclusion.
[7] Submit concrete plan to higher management for budget approval and establishes cleaning work instruction.
[8] Thesis writing-up.