ANNEX 6.6

6.6 Information Provided by JICA Study Team for Waste Minimization

1. Chemical Industries

Waste Minimization: Case Study on Chemical Industries

1.1 Requiring with extra efforts and enforcements

1) Mental enforcement

a. Understanding and willingness by top management in improving of WM
b. Change of employees' mentality

2) Actual enforcement

a. Identify of a present situation
Measures consumption of raw materials, energies and manpower and a necessary production space and times that require with manufacturing of current products.
Static analysis per unit product and compare with competitors
b. Setting a goal (target) and time framing
One of strategy taking in Japanese companies is [**4S + 1H**] as promotion of WM
[**4 Saves**]
i) Save Energy
ii) Save Labor
iii) Save Space
iv) Save Waste

[**1 High**]
i) High Quality

3) Execution

i) Plan
ii) Do
iii) Check
iv) Action

4) Evaluation

Results shall be visually evaluated and awarded.

1.2 Successful Story

1) Recovering VCM from PVC Production

Process Description:
When residues (non-reactive) of VCM (Vinyl Chloride Monomer) are recovered from PVC (Polly Vinyl Chloride) through the "Suspension Polarization Process" and recycled them, low flushing points of impurities such as nitrogen gases, inert gases, which have been used in the reacting process, and also Methyl Chlorides in the raw materials, are condensed through the recycling process. When the concentration of Methyl Chloride is above some certain level, it causes the density fluctuation in the PCV Products. Therefore a fractionator can recover these impurities, however the loss of VCM Product is unavoidable because of that VCM and Methyl Chloride are very close flushing point.

Measure taken:
In order to solve such losses of VCM, the Gas Chromatography Absorption/Desorption System, which can separate Methyl Chloride and the VCM by their differential absorption efficiencies on an activated carbon, has been developed and is utilized.

The process advantages are:

i) Can recover VCM with high concentration and high efficiency by avoiding losses of raw materials (PCV)
ii) Can save the energy as the heat source without operating of the fractionator.
iii) Environmental advantage by good emission level
iv) Can save the space by dismantling fractionator

2) Recovering Silver from Photograph Film Production

Process description:
In a film manufacturing industry, an excess amount of silver bromides are normally discharged into an effluent. An assorted several types of high polymer coagulants is applied to recover these materials. However it is rather difficult to separate the silver metal from the assorted high polymer coagulants.

Measure was taken:
The captured silver metal can be separated from the assorted high polymer coagulants by the incineration.

3) Recovering solvent, as Trichloroethylene

Process description:
A Particle Arrester, which is made by felt materials as elements, is widely used in the nuclear industries to remove ultra fine particles. The ultra high efficiency filter is manufactured by the contact method of the phenol solvent with the felt fibers, and then the felt fibers are cured by the phenol resins.
The remained solvent is forced to evaporate by the heated air. Toluene is normally used in a past, but it was replaced by the Trichloroethylene due to flammable materials.

Measure was taken:
Install a high efficiency recovering system and then the solvent can be recycle.

4) Reduce a consumption of rinsing water in dyeing industry

Process description:
Rinsing water is directly discharged as effluents without recycling.

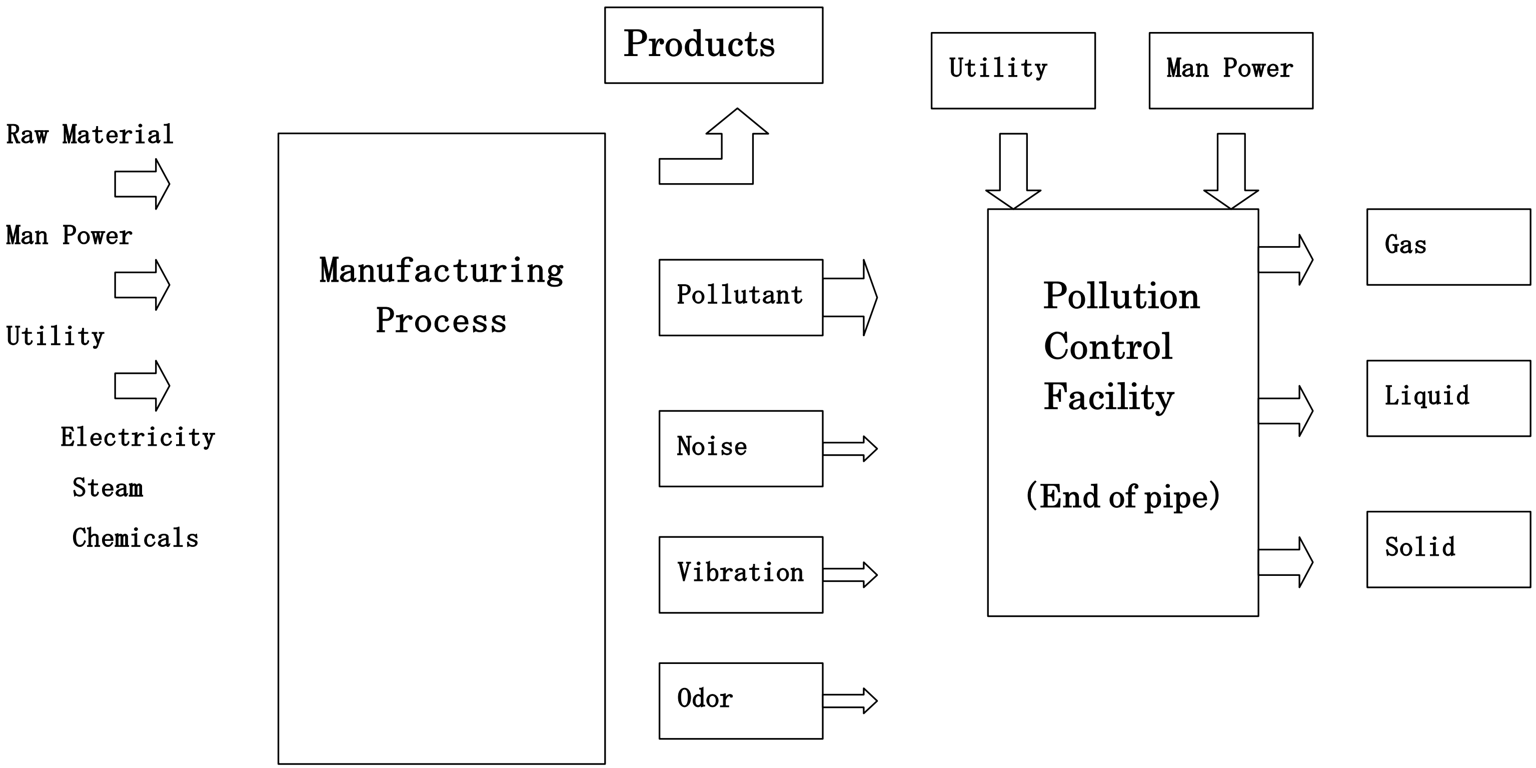
Measure was taken:
Installed several number of rinsing tanks and modified the effluent system by adopting of the counter flow system, and then could reduce the water consumption.
When the water supply valves are reduced by a half-turn, it can save 10% of the water consumption.
Checked all water valves whether the necessary and sufficient amount of process water was supplied to each process

Fig. 6.5. 1. Concept Diagram of Process

Concept Diagram of Process

J E M A I

July 5'02 H.Uchiyama



2. Pulp & Paper Industries

2.1 Comments on Monitoring Report & Water Balance Data (Mr. Sambyakugari)

１. Comments and Question
* Need information whether the water balance on the block diagram describes a current or future condition?
* According to the diagram, unit water consumption per product is 19 m^3/ton when the production rate is 76 m ton/day.

250+13.2=263.2G/M
263.2×0.003785×1440＝1434m3/d
1434/76=19m3/t

Because of that the current water consumption per product is 50 m^3/p ton according to III on the WM Implementation Progress Monitoring. Therefore may I understand that the 50 m^3/ p ton is shall be reduced until 20 m^3/p ton.

Accordingly, I think it will be very successful output, if fully satisfied.

２. Sludge
* The most of paper sludge are incinerated in Japan.
* The ashes are effectively utilized as raw materials for cement manufacturing plant (kiln).
* However partially landfilled.

Waste Minimization: Case Study on Pulp & Paper Mill Industry

2.2 Success Stories

Good house keeping practice with "5S"

By implementing of the "**5S**"practices, which are *"Seiri" [**S**orting Out], "Seiton" [**S**ystemize], "Seisou"[**S**tandardize], "Seiketu" [**S**anitize] and "Shitsuke" [**S**elf-discipline]*, the production environment and the safety condition has been improved. As a result, the product quality has been achieved with a stable condition. Accordingly better quality products can be manufactured by a clean environment, but not by a disorganized environment.

Segregation of discharge lines

Segregating of a rainwater drain line from product water lines can reduce a requirement of wastewater treatment capacity. The rainwater can directly discharge into a sewer or standard effluent line without treatment.

Improve of productivity

1) Cleaning of paper mills
Periodical cleaning of mills, tanks and chests possible to prevent that the generated slimes and excess pulps are decayed. As a result, products quality could improve and reduce the contamination of impurities and darts that was causes of bad odors.
2) Setting fourdriniers in proper arraignment and cleaning chests and holding tanks
These are essential practices and can give a great result on the products quality. If the chest and tanks are stained with black spots and these are never decomposed, the product papers may be easily broken in a production or black spots may be stained on the products, as a result, these products are claimed back.
3) Cleaning wet parts of fourdrinier machines

By cleaning of wet parts of the machines, contaminations, which are stacked on their approaching pipes and internal parts, could be removed through circulating of caustic soda solution within 5 to 6 hours. The product qualities have been improved as well as damages of the paper breaks have been reduced. It is exactly better productivity.

4) Washing fourdrinier machines' parts
   a. Cleaning felts
      When the fourdrinier machines are not in operation, all contaminants on the felts should be washed out by caustic soda solution. While the machines are operating, these are kept in clean condition by using of felt cleaning agents to avoid sticking of contaminants.
   b. Cleaning canvases
      While the machines are not in operation, canvases should be washed out completely by the steam and compressed air. As a result, the steam consumption could be saved, and also operating speed has been increased because of that excess moistures had been removed from the paper.
5) Washing by high pressure water
   It is extremely important to completely wash out contaminants by high-pressure water while the machine are not in operation. It is also necessary to prevent filters and wires from clogging in the operation in order to improve the yield rate.

Quality control

The crown of rollers must be adjusted to keep the paper with constant thickness, if the machine dose not furnished with the crown control mechanism.

2.3 Unsuccessful Stories

Contamination

It has been taken a lot of times to find out an actual cause that red spots had been shown on the product papers, like plastics impurities. Then it has been kept to produce many defects without recognizing that small shrimps had been in the process water taken from the sea.

What measure was taken:
► Automatic self-cleaning filter was installed in the seawater intake line.

Utilize white water into waste paper line

When the white water, used once in the de-inking process, was utilized on fourdriniers in order to improve its yield rate, however it have generated many defects because of that "sizing agents" had never worked effectively due to remaining inks.

What measure was taken:
► Using of the white water was stopped.

Utilize white water discharged from other machines

When the white water, used once in another fourdriniers, was utilized on machines in order to improve its yield rate and dehydration. These improvement were observed while the another fourdrinier machines are in operations, however due to the condition of dehydration was changed, paper breakage was occurred, then generated lots of defects caused from moisture changes of the papers.

What measure was taken:
► Using of white water was stopped.

Continuous operation of old machine

Role shafts used in old machines might be cracked by causes of the metal fatigue, and then breaking of a shaft suddenly broke down the machines. And it caused serious operation loss as well as lower productivity.

What measure was taken:
► Replace a roll depending upon results by non-destructive inspection, as x-ray or color dye.

2.4 Waste generation in the Pulp and Paper Industry in Japan

1. Status in 2000

1.1 Waste category and Types

Table 6.5. 1. Waste Category and Type

Waste Category	Type of Waste
Ashes	Coal burning ashes, Residues of other fuels
Inorganic Sludge	Caustic sludge, Flue gas treatment sludge, Paint sludge, Water purification sludge
Organic Sludge	Wastewater treatment sludge, Waste pulp residues
Waste Oil	Waste oil, Waste ink
Waste Plastics	Used tools and equipment of pulping machine, Plastic containers and piping materials
Waste Paper	
Waste Wood	Chip dusts, Waste pallet, Wood chips
Waste Steel	Steel parts, Steel container, Drams, Steel chips from waste paper
Rubbles	Rubbles, Demolition concrete and glass wastes
Dusts	Collected Dusts
Others	

1.2 Waste generation and recycled amount
1) Unit amount per product

Table 6.5. 2 Unit Amount Per Product

Unit	1999	2000
BDkg per Product ton	101	98

2) Categorized amount

Table 6.5. 3 Categorized Amount

Waste Category	Generated Amount		Recycled Amount	
	BDkg/Product ton	%	BDkg /Product ton	%
Ashes	345,000	13.0	304,000	22.9
Inorganic sludge	101,000	4.0	67,000	5.0
Organic sludge	1,710,000	62.0	597,000	44.9
Wood chips	126,000	5.0	29,000	2.2
Dusts	259,000	9.0	252,000	19.0
Others	225,000	7.0	81,000	6.0
TOTAL	2,675,000	100.0	1,330,000	100.0

2.5 Maintenance Guide to Noah's Paper Mills

Table 6.5. 4 Maintenance Guide to Noah's paper Mills

Items	Causes	Measures
Clean the internal surface of Chest and Tanks	Dirt and Stains are accumulated with floated foams at the ceiling plate of Chests and Tanks. These are causes of paper breakage due to "Dirt-spots" on the paper surface, if no regularly removed.	The chest and Tanks shall be washed by high-pressure water jet. The oxygen in the internal air must be monitored in the tanks and the safety shall be secured, if workers will be worked inside. Installing of a mobile type high-pressure washing spray system more effective tools at the facility.
Clean the Wire/Pipes, Silo Inlet of Foundrinier Machine by circulating of caustic soda solutions.	Circulate a caustic solution into the white water lines to remove stains and dirt around the Wires while in maintenance period.	Inlet: White water Silo Concentration:5% of White water amount Just drifting smells with the caustic soda at Wires Circulation time: 6~8 hours Cleaning cycle: 1/month The caustic soda solution shall be completely washed out by the water.
Pulping adhesion on DSA is poor	It is assume that DSA's Filter are clogged so that pulping adhesion is poor condition.	Filter shall be completely cleaned by high-pressure water jet or dismantle to clean.
The dry-line shall be kept more stable condition on/above the Wires.	Some parts are reached onto Couch-Roll so that the water profile is not appropriate condition toward paper-wedge.	Take an adequate opening for the Inlet-Lip. Foil-Edge shall be checked. Wear condition on the top plate of Suction-box.
Adjustment the opening of the Inlet-Lip	Thickness-profile for papers and a formation between them become inadequate conditions.	Lip-opening shall be periodically measured and adjusted with desirable gap.
Lip inside at top-inlet shall be cleaned.	Jet-cracking will be occurred as well as a formation between paper layers become inadequate conditions, if the dirt will be accumulated in the Lip inside.	Dirt inside the Lip shall be completely removed.
Wears and cracks on the edge of wheels shall be regularly checked.	Unbalancing of dehydration is occurred onto the wedge-side of paper and water-profiles become inadequate conditions.	Wheel shall be replaced or machine-polished.
Periodical maintenance shall be scheduled for the Foundrinier Machine	Maintenance and cleaning shall be periodically curried out.	Periodical Maintenance: 8~10 hours per month Replace of tools and paper:

Items	Causes	Measures
		5~8 hours per 2 times per month
Blanket shall be wash-cleaned while the Foundrinier Machine is in maintenance.	Dirt shall be removed so that the dehydration ratio shall be improved.	By caustic soda washing shall be required and then after de-alkalization shall be curried out by water washing. The concentration of caustic soda solution shall be determined by consultation of manufacturers.
Canvas shall be cleaned by water washing while not in operation.	Dirt on the canvas shall be removed so that dry-efficiency can be improved.	Dirt can be removed by blowing of steam and air, or remove to wash.
Crown-roll of Foundrinier shall be machine polished.	Unstable paper thickness and wrinkles caused by reducing of crown-roll and uneven wearing condition can be prevent.	Periodical machining shall be scheduled.
Plan to reduce using of clean water in the process.	Reuse water, once used to clean blankets and recycled.	Self-washing filter shall be installed, however periodical cleaning required.
Paper-formation for thicker paper is inadequate condition caused by flock-formation.		Ratio of Jet and Wires shall be adjusted. Concentration into the Inlet shall be reduced. Dehydration efficiency shall be improved on the Wire-parts, or speed shall be reduced.
Pre-screen of used-paper machine is clogged by films.		Rejections shall be increased by screens or the flow rate shall be reduced.

3. Food Processing Industries

3.1 TSB Enterprise Inc.

1. Raw Materials and Consumption

The main products are mango's puree and cube that are used for materials of ice creams, however these can be converted various type of raw materials (additives) depending upon harvesting seasons. In addition other fruits and also agricultural products are processed into various type of food products.

Table 6.5. 5 Consumption of Main Raw Materials

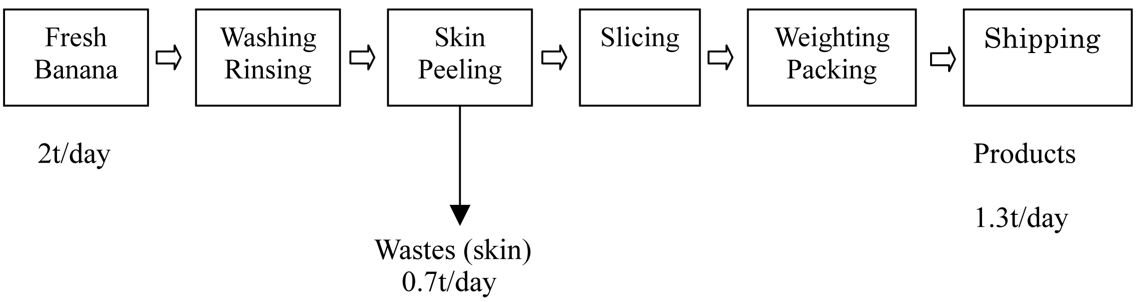
Raw Materials	Consumption
Mango	8~10 ton/day
Wobe	2 ton/day
Strawberry	1.5 ton/day
Banana	2 ton/day
Pineapple	2 ton/day
Peanuts	1.2 ton/day

2. Main Process

a) Banana Slicing Production

The following line basically produces the banana slice products. (Slicing line is only visible, when visited)

Fig. 6.5. 2. Main Process of Banana Slicing Production



b) Coconuts Puree Production

c) Bakery Production (Cakes)

Both production are unable to see when visited, however a warming up purees are transferred from 1 m^3 of polyethylene tank for measuring and bottling process. A bakery line is operating to manufacture cakes.

3.2 Jo-na's International Inc.

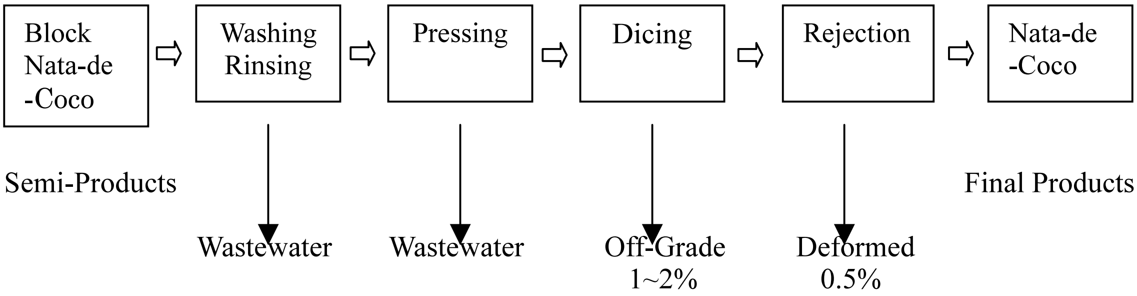
1. Production and Raw Materials

Main products produced in lines are snacks, noodles, preservative fruits-cakes and nata-de-coco, and also includes frozen open fishes. And also exporting nata-de-coco and banana chips are produced. But the most of raw materials are not fresh-goods and consequently purchased as primary processed goods from outer production companies or subcontractors. At the production of frozen opened fishes for an example, the capacity of 1.5 ton/day, as the final production generates 30% of wastes from primary treated materials. Nata-de-coco is produced with 1 ton/day from coconuts-milk provided from contracted suppliers. The final nana-de-coco is formed in size of 30^{W}x 40^{L} x 1.5^{T} cm and then frozen to store. Nata-de-coco is normally rinsed and pressed to de-water, and then these are diced in small cube by the blanking cutter for delivering.

2. Main Process

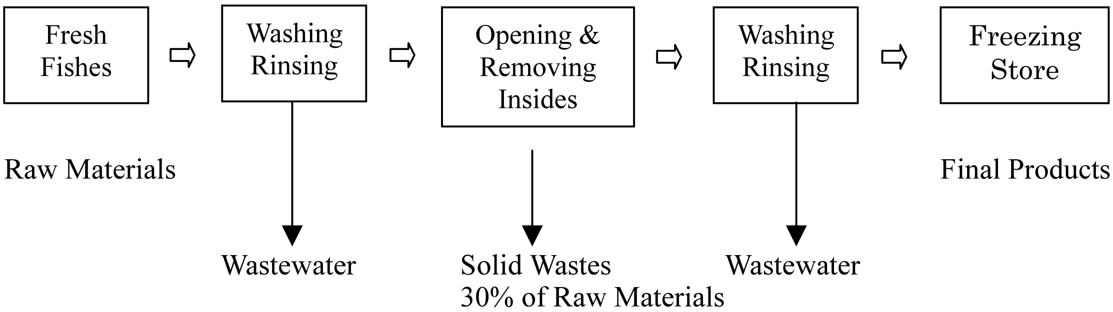
a) Nata-de-Coco

Fig. 6.5. 3. Main Process of Nata-de Coco Production



b) Frozen Open Fishes

Fig. 6.5. 4. Main Process of Frozen Open Fishes Prodution



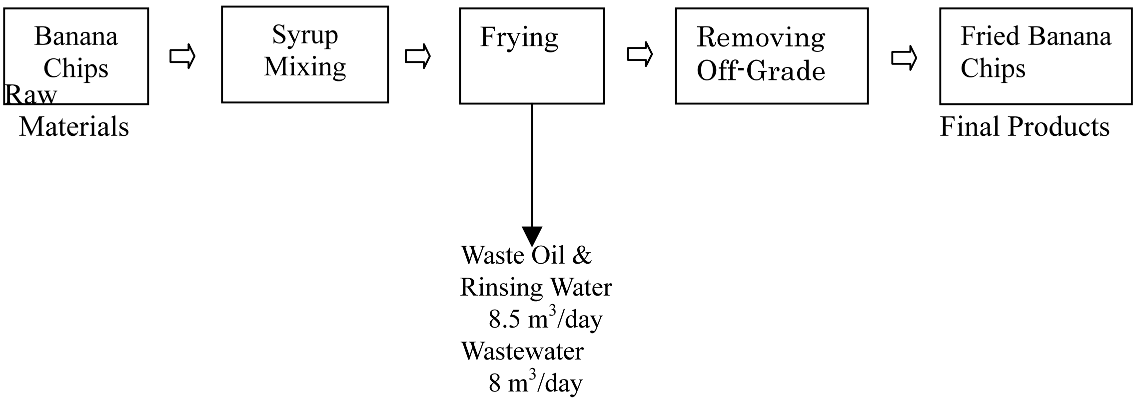
3.3 BFC Worldwide Inc.

1. Production and Raw Materials

Fried banana chip is a main product. Raw materials are dried banana chips provided from outer suppliers. The fried banana chips are completely cooked by fully mechanized finishing process except a quality inspection line. The off-grade products (fried banana chips) are manually removed and these can be used for domestic market, or animal feeds.

2. Main Process

Fig. 6.5. 5 Main Process of Banana chips Production



3. Waste Treatment

The wastewater and oils are separated through the "Sequential Batch Type Reactor System", however the quality of effluents is unstable. The generated sludge are naturally dried under the sunlight and utilized for fertilizer and/or soil conditioners in the plant area. The existing capacity of treatment system will be unsatisfied with increasing wastewater (5~10 m^3/day), when a new production, which can produce 20 ton/day of banana chips from fresh fruits, will be installed. The oil separator shall be modified into three times batch treatment system for the new production that will be 24 hours operation (The existing production is 2 shifts x 6 hours). However it will be considerable that the new production system expectedly generates about 10 ton/day of banana skins.

3.4 General impression on the Philippine Food Factories

The production of 3 factories visited by us employ with rather small-scale processing and these utilize mainly agricultural such as fruits and etc., includes partially fishery products as main raw materials. Those factories discharge wastewater with less than 50 m^3 per day that is almost similar volume discharged by Japanese typical small-scale food industries. It is realized that the wastewater is discharged with natural organic materials such as sugars, fats and proteins. Basically the small-scale and/or micro-enterprise food industries are less capital strength as well as lack of manpower in an operation than that are carried out by large-scale enterprises. In addition these small-scale industries are only limited in improving productivity by mechanization in food processing due to using of particularly fresh raw materials. Consequently it shall be recognized from a viewpoint of the waste minimization process that a basic subject is how the conversion rate (or recovery rate) that is production yield rate should be improved from the first stage of the raw materials to a completion of final products. And also how the wastes should be converted into valuable resources in order to re-used in the process.

3.5 Wastewater Treatment System carried out in the food processing companies

The TSB Enterprises, Inc. directly discharge the wastewater into public swear system without any treatment, however other two companies, which are Jo-No's International Philis, Inc. and BFC Worldwide, Inc. are employed with the biological treatment system. However according to these companies, it is reported that the effluent quality is unsatisfactory though treated by the system. Therefore this problem should be a future subject that the JICA Study Team shall propose a concrete planning to improve the wastewater quality. In order to achieve these improvements, however it is necessary to obtain a time series data of volume and quality of the effluents through the production process. The biological treatment system is principally breeding and controlling method and therefore it is required with a basic knowledge of the bacteria to maintain an optimum biological condition. Thus, applying of "Biofilm Process" is one of solution to easily control if their engineering knowledge are enough satisfactory.

The TSB Enterprises, Inc., and Jo-No's International, Inc. are furnished with many manual processes lines because of that their products are materialized with vegetables and fishes as raw materials. However these factories are kept good sanitized condition in process as well as production controlling. It is very many impressive results caused from that they are really worldwide exporting many of products. These industries discharge all wastes, such as solid wastes, which are generated from the raw materials at the first stage of production to the completion of final products, into the public disposal land at present. However it is realized that these wastes should be recovered and reused as valuable materials in a future.

The BFC Worldwide Inc. is manufacturing "Flied Banana Chips" when visited, utilizing "Dry Bananas" by the latest automated machines but not applied to sort off-grade products in the process line With regard to their wastewater treatment system, it is not easy to treat because of single process.

It is said that if the production is too much concentrated on single process depending upon a type of product.

The Jo-na's International Philis, Inc. on the other hand, their level of COD is 200 mg/l, which is unable to satisfy with the COD Standard (less than 100mg/l) even though their effluent condition can achieve 8 mg/l, which can clear BOD Standard (less than 50mg/l).

Japanese Policy on COD Control:
In Japan, the COD is strictly controlled only for the lake and pond, and semi-enclosed bay where is the low-water-exchange-condition in the water basins (where the drainage can be kept with a long resident time), if the effluents are discharged. This object of the control is to avoid the eutrophication process caused by accumulating of COD that is not by BOD.

Control Mechanism of BOD and COD:
The BOD shows principally the pollution index defined as "easy-decomposable-organic" that rapidly consumes the dissolved oxygen when the large amount of organic pollutants is discharged into the water basin and consequently aquatic organisms are imperiled with the biological survival. Instead, the COD is the index defined that all materials to be oxidized are reacted by the strong chemical oxidants, such as permanganate, bichromate and as a result, it is possible to quantify the refractory-organic, reduce-able substances in a chemical reaction.

However the factories effluents, discharged into the water-basin of the rivers and the lakes, unless it is not as a large-scale water-basin, can reach within 2~3 days to the ocean area. In a case, BOD shall be controlled with organic pollutants that may be possible to cause a negative impact to the environment in such a short period. These organic pollutants shall be strictly controlled by the index as BOD.

Mostly in developing countries, including Philippines, they automatically adopt the high standard that is developed by high-industrialized European Countries without understanding such mechanisms From this situation, it seems that Japanese Regulatory is more rational and applicable method for Philippines Environmental Act. A reason is that the bacteria colony (it is named as activated sludge) and the effluents (it is called as raw water) contacts principally as long as 20 hours in the Oxygen Demand Bacteria Process utilizing of the activated sludge, which is employed as the most common wastewater treatment system. It is recognized that "easy-decomposable-organic"(relatively light molecules) named as BOD is only decomposed in this process. The "refractory-organic" (that is not easy to decomposed, such as high polymer-cellulose, pentose-materials containing in grain skins) defined as COD is never decomposed in this process. However, it is consequently that the effluents are never polluted in the water basin, if the BOD is completely decomposed (eliminated) through the wastewater treatment process.

Applicable Technology for High COD Treatment:
Consequently, it is required with high financial liability, if applying of high standard of COD without understanding of that mechanism and as result; it may be a risk of falling international competitions. The process of decomposing of high COD is generally carried out by the tertiary treatment, or advanced treatment. This process is uneasy technology applying developing countries, if not be fully understanding as well as financial supporting.

3.6 Applicable Technologies for Waste Minimization

3.7 Applicable Treatment Technology for Solid Wastes

The solid wastes discharged from food industries are residues of the raw materials that are from agricultural, livestock, and fishery products and off-grade products (includes intermediate) in the production process and also including sludge removed by a screen device of the wastewater treatment system. These are quite perishable materials due to the organic state and also having difficulty in handling as well as transporting. This condition shows that the discharged wastes shall be required to rapidly treat at on-site or the nearest location of the factories, if such wastes are going to be recycled as valuable products. Selecting of a treatment process shall be quite limited and in addition from the economical viewpoint as well as the above circumstances, it is almost impossible to utilize the recovered wastes (valuable materials), if these may not be consumed within the nearest location of the production area. Thus utilizing of the recovered wastes is very much depending upon a site condition of factories where the wastes are discharged. The following are some of examples that have been succeeded since applied by try-and-error method in Japan.

a) Convert to Compost

Residues of agriculture, livestock and fishery products shall be crushed in small sizes, however if these wastes are saw dusts and/or rice chaffs, should be mixed with livestock excretes, and then these wastes shall be fermented by investing a lot of times under an alternative condition with the aerobic and anaerobic environment. There are many effective experiences in utilizing as delayed organic fertilizers in agrarian areas. And also some of these are most applicable as a soil conditioner to accelerate forming of crumbled structures rather than utilizing as fertilizers instead.

b) Recycle to Animal Feed

Fish food processing, including canning dispose bones, skins and inner parts, as residues from raw materials. These materials can be converted into highly energizing materials containing with amino acids, proteins, calcium and vitamins such as named as fish meals and /or soluble matters through the enzymatic hydrolysis process, and can be utilized as nutritional supplements by mixing with and/or adding to animal feeds. This method is one of a considerable usage for a large-scale production and also residues of freshly vegetables and fruits from raw materials can be directly utilized for a part of animal feeds.

c) Recycle as Heat Source: Method I (Combustion Method)

As recycling of organic solid wastes, a method of combustion after drying is the most common process to obtain the thermal energy since an ancient time. The energy can be utilized as fuels for homes as well as light-duty boilers of factories. However these fuels now become widely using as effective fuels for the high efficiency heat recovery furnace since various types of furnace or melting furnace that have remarkably innovated in the 20 century.

3.8 Applicable Measures for Liquid Wastes containing with Fine Solid

a) Recycle as Heat Source: Method II (Wet Oxidization Method)

This process that named as "Zimmerman Process" or "Wet Oxidation Process" is the method to recover the heat energy from slurries that includes emulsified liquids, which have been separated through a screen devices (effective slit gap is around 1~2 mm) or highly concentrated liquid organic wastes. This process is required with the high temperature and pressure to recover the heat energy that is reacted through the chemical oxidation process by mixing with the air and highly concentrated liquid organic wastes (wastewater). This process can be applied to highly concentrated waste liquids or slurries, such as pulp digestion waste liquids, waste molasses, waste liquids from alcohol distillation process and/or excess concentrated sludge from the wastewater treatment plant, which are contaminated with at least ten thousand ppm of COD or more. This process also has a big advantage that can treat organic wastes contaminated with bio-toxic or inhibitors, which can generally be untreated by biological treatment.

This process starts reacting at 220~240℃ and 40~60 kg/cm^2 when wastes are natural organic materials. The process is reacted by providing with starting-heat and can hold a constant temperature without requirement of additional heat, once the reaction has been stable condition. However an operation of the process shall be required with monitoring and supervisor by a certified operator in Japan, due to it is principally reacted under the high temperature and pressures.

b) Recovery as Methane Gas

The liquid organic wastes includes emulsified fine materials are processed by the methane fermentation called as an anaerobic fermentation, and then the methane gas is formed through the second-stages anaerobic fermentation process that is a combination of the acid and anaerobic fermentations. The recovered methane gas can be used as fuels, however it is experimentally tried to generate the electric power by utilizing of fuels for the Fuel-Cell Devices to recover the hydrogen from the methane gas. A purpose of applying this process is basically used to treat sludge from sewage treatment system in order to minimize the disposal aerobic sludge as well as reusing, however it is rather difficult to control the process.

3.9 Conclusion

The above said technologies are widely applied to minimize as well as effectively recycle the various types of solid organic wastes and high concentrated organic liquid wastes. However it may be possible to develop another method under special consideration of special local requirement in addition to these technologies. A point that required in manufacturing industries with the waste minimization is to maximize rate of the conversion from raw materials to final productsIt should be focus on how the highest yield rate will be achieved and as a result, how the highest valuable materials can be economically recovered from disposable wastes.

In order to effectively achieve these technologies, it is necessary to figure out the best measure by accumulating of knowledge developed by the local government and academic institution that should know local industries, also actual conditions of the region. Consequently it is required that the waste minimization program shall be developed and accomplished to be satisfied with local special and actual conditions by a joint research between Industry-University.

3.10 Required Information for Waste Minimization

The following information is a general requirement for planning of measures for the waste minimization.

1) Latest data for monthly production amounts and trends for main products (3~5 items)
2) Fresh (Raw) materials for main products and harvest and/or fishery season. (Month to Month)
3) Average consumption per each main product per day (kg/day, or ton/day)
4) Average solid wastes disposal amount per each main product (kg/day, or ton/day)
5) The latest 3 years water (city, well water) consumption per month and trends for the operating month (m^3/month)
6) The latest 3 years data of waste water generation per day and trends for the operating month (m^3/day)
7) Design, Flow Diagram, Capacities and Capabilities of Equipment for the Wastewater Treatment System, if existed and operated. (Copy)

4. Metal Casting Industries

4.1 Minimize Wastes in Foundry Industry

1. Foundry Sand

Sand used at foundries is of a high quality and stringent physical/chemical properties must be met as poor quality sand can result in casting defects. Foundries invest significant resources in quality control of their sand systems, with extensive testing done to maintain consistency. As a result, RFS from an individual facility will generally be very consistent in composition.

2. Sand Binding System

Two general types of binder systems are used in metal casting: **clay-bonded systems (green sand)** and **chemically-bonded systems**. Both types of sands are suitable for beneficial use but they have different physical and environmental characteristics.

1) Green Sand

Green sans is the most commonly used RFS for beneficial reuse. It is black in color, due to the carbon content; has a clay content that results in a percentage of the material that passes a 200 sieve; and adheres together due to the clay and water.

Green Sand molds are normally used to produce about 90% of casting volume. **Green sand** is composed of naturally occurring materials which are blended together: high quality silica sand (85-95%); bentonite clay (4-10%) as a binder; a carbonaceous additive (2-10%) to improve the casting surface finish; and water (2-5%).

2) Chemically-bonded Sand

Chemically-bonded sand are used both in coremaking, where high strengths are necessary to withstand the heat of the molten metal, and in mold making. Most chemical binder systems consist of an organic binder that is activated by a catalyst, although some systems use inorganic binders. Chemically bonded sands are generally light in color and coarser in texture than clay bonded sands.

3. Recycled Foundry Sand (RFS)

Foundries produce RFS generally in proportion to their overall production volume, although there are different sand-to-metal ratios employed in different casting processes and products.

Most foundries have two sand systems, one feeding the external molding lines and one feeding the internal core lines. After the metal is poured and the part is cooling, green sand is literally shaken off the castings, recovered and reconditioned for continual reuse. Used cores are also captured during this cooling and "shake out" process; these break down and are crushed and reintroduced into the green sand systems to replace a portion of sand lost in the process. Broken and/or excess cores, or those cores that do not break down, are discarded.

Recycled foundry sand (RFS) is high quality silica sand with uniform physical characteristics. It is a byproduct of the ferrous and nonferrous metal casting industry, where sand has been used for centuries as a molding material because of its thermal conductivity. In modern foundry practice, sand is typically recycled and reused through many production cycles.

Depending on the projected end use, it may be important to segregate sand streams at the foundry as each stream can have different characteristics. Additionally, some sand is typically unrecoverable during the "shake out" and finishing processes. These sands may be contaminated with metal and/or very large chunks of burned cores (referred to as core "butts") and will need to undergo some type of segregation, crushing and screening before recycling.

4. Beneficial Reuse of RFS

The some volumes of RFS are currently used in geotechnical applications such as road bases, structural fills, embankments, general fills and landfills. The high quality of the sand makes this industry byproduct an excellent aggregate for manufactured products such as Portland cement, flowable-fill, asphalt, and concrete products. In more limited instances, RFS is being used in manufactured soils and other agricultural applications depending upon level of contamination.

1) Foundries lead Recycle

Metalcasters are some of the world's first recyclers. For centuries, foundries have been making new metal objects by remelting old ones. In fact, the oldest existing casting is a copper frog made in Mesopotamia and dating back to 3200 BC.

Old and discarded products such as appliances, sewer grates cans, automobiles and water meters are not trash to foundries –they are raw materials. Foundries convert this unwanted scrap metal and recycle it into valuable products such as faucets, engine blocks, golf clubs, aluminum wheels and much more.

2) Foundries create new life for used sand

Casting processes require large volumes of sand, which are continually used, reconditioned and reused in the foundry. Sand that can no longer be reused in the foundry process is available for beneficial reuse. Most foundries have installed sand reclamation systems that screen the metal and debris out of the sand so that a good, clean product is available for reuse in a variety of applications and industries.

3) Market for Used Sand

- Construction Fill
- Road Subbase
- Grouts and Mortars
- Potting and Specialty Soils
- Cement Manufacturing
- Precast Concrete Products
- Highway Barriers
- Pipe Bedding
- Asphalt
- Cemetery Vaults
- Brick and Pavers
- Landfill Daily Cover

5. Save energy and Reduce pollution

Making castings from recycled metal products saves energy and conserves resources. Since foundries produce castings with recycled content, we are able to reduce our needs for raw materials and energy. Processing raw materials places heavy demands on the nation's energy resources; however, it requires 95% less energy to make castings out of recycled metals.

- Reprocessing used materials in the foundry industry also has a domino effect by reducing the energy demands for mining, refining and many other metal-related processes.
- Recycling also reduces pollution risks by keeping materials out of disposal facilities. For instance, reusing steel reduces both water and air pollution and saves water, compared to making new steel from iron ore. According to the U.S. Environmental Protection Agency (EPA), recycling steel, rather than using iron ore, reduces air pollution by 86%, water use by 40%, water pollution by 97% and mining wastes by 97%.

6. Possibilities

- Foundry sand may clear leachate standards.
- ZERO waste: Foundries can treat and recycle all of their wastewater, sand and other refuse, or find beneficial reuses for it, producing no waste to be landfilled.
- Foundry sand can be used to make concrete, cement, block and bricks — all of which are basic construction materials.
- Foundry sand and other recycled materials are commonly found in roads (asphalt), gardens (mulch), building (blocks), parking lots (concrete) and recreation areas (specialty topsoils).

4.2 Comparisons on Molding Sand in Iron Casting

1. Sand Binding System

Two general types of binder systems are basically used in iron casting:

a. Clay-bonded systems (green sand) and Chemical-bonded systems.
b. Both types of sands are suitable for beneficial use but they have different physical and environmental characteristics.
c. Most foundries have two sand systems, one feeding the external molding lines and one feeding the internal core lines.
d. After the metal is poured and the part is cooling, green sand is literally shaken off the castings, recovered and reconditioned for continual reuse.
e. Used cores are also captured during this cooling and "shake out" process; these break down and are crushed and reintroduced into the green sand systems to replace a portion of sand lost in the process.
f. Broken and/or excess cores, or those cores which do not break down, are discarded.

1.1 Green Sand

a. High quality silica sand (85-95%); bentonite clay (4-10%) as a binder
b. A carbonaceous additive (2-10%) to improve the casting surface finish; and water (2-5%).
c. Green sand is the most commonly used RFS for beneficial reuse. It is black in color, due to the carbon content; has a clay content that results in a percentage of the material that passes a 200 sieve; and adheres together due to the clay and water.

1.2 Chemical-Bonded Sand

a. Chemical bonded sands are used both in coremaking, where high strengths are necessary to withstand the heat of the molten metal, and in mold making.
b. Most chemical binder systems consist of an organic binder that is activated by a catalyst, although some systems use inorganic binders. Chemically bonded sands are generally light in color and coarser in texture than clay bonded sands.

1.3 Resin Shell Molding Sand

a. Known as the Croning Process, developed by Germany
b. A resin coated sand mix being dumped onto a heated pattern plate.
c. The sand is hardened under the influence of the heat and then the mold is normally glued together for casting.
d. The shell molding process is a precision sand casting process capable of producing castings with a superior surface finish and better dimensional accuracy than conventional sand castings.
e. These qualities of precision can be obtained in a wider range of alloys and with greater flexibility in design than die-casting and at a lower cost than investment casting.
f. The process is the use of fine-grained, high purity sand that contributes the attributes of a smooth surface and dimensional accuracy to molds cores and castings alike.
g. In shell molding the fine sand is coated with a thermosetting resin which provides the relatively high strength required enabling a thin section, or shell, mold to be produced.

4.3 Comparison Table of Molding Sand

Table 6.5. 6 Various type of Molding Sand

TYPE OF MOLDING SAND	DESCRIPTION	REQUIREMENTS & CHRACTERISTICS
Green Sand (Clay-Bonded Sand)	* Normally used to produce about 90% of casting volume. * Clay-bonded sand that composed with high quality Silica sand (85-95%) and Bentonite clay (4-10%) as a binder. * Mixed with a carbonaceous additive (2-10%) to improve the casting surface finish and water (2-5%).	* It must pack tightly around the pattern, which means that it must have flowability. * It should be capable of being deformed slightly without cracking, so that the pattern can be withdrawn. In other words, it must exhibit plastic deformation. * It must have sufficient strength to strip from the patter and support its own weight without deforming, and to withstand the pressure of molten metal when the mold is cast. It must therefore have green strength. * It must be permeable, so that gases and steam can escape from the mold during casting. * It must have dry strength, to prevent erosion of the mold surface by liquid metal during pouring as the surface of the mold cavity dries out. * It must have refractoriness, to withstand the high temperature involved in pouring without melting or fusing to the casting.
Chemical-Bonded Sand	* Used both in core making and in mold making. * Withstands the high strengths and heat of the molten metal. * Generally light in color and coarser in texture than Green Sand (clay bonded sands). * Most chemical binder systems consist of an organic binder that is activated by a catalyst. * Although some systems use inorganic binders.	* Molding sand, in addition to water and clay is contained with organic materials to improve molding characteristics and properties.

TYPE OF MOLDING SAND	DESCRIPTION	REQUIREMENTS & CHRACTERISTICS
Resin-Shell Molding Sand	* Capable of producing castings with a superior surface finish and better dimensional accuracy than conventional sand castings. * Use of fine-grained, high purity sand that contributes the attributes of a smooth surface and dimensional accuracy to molds cores and castings alike. * The fine sand is coated with a thermosetting resin that provides the relatively high strength required enabling a thin section, or shell, mold to be produced. * The mold should accurately replicate the pattern detail and dimensions if a precision casting is to be produced * The resin bond is developed whilst the mold is in contact with a heated pattern plate. * The mold is separated from the pattern without the need to enlarge the cavity, as is the case in green sand molding. * A further improvement in casting accuracy can be obtained if zircon sand is used instead of silica sand.	1. Advantages * Lower capital plant costs, when compared with mechanized green sand molding * Capital outlay on sand preparation plant is not essential * Good utilization of space * Low sand to metal ratio * Mold coatings are unnecessary * Light weight molds are produced which are readily handled and have good storage characteristics * Skilled labor is not required * Shells have excellent breakdown at the knockout stage * Lower cleaning an fettling costs * Castings have a superior surface finish and dimensional accuracy, when compared with green sand molded castings **Disadvantages:** * The raw materials are relatively expensive * The size and weight range of castings is limited * The process generates noxious fumes which must be effectively extracted

4.4 Recycled Foundry Sand (RFS)

Recycled foundry sand (RFS) is high quality silica sand with uniform physical characteristics.

- A byproduct of the ferrous and nonferrous metal casting industry
- Sand has been used for centuries as a molding material because of its thermal conductivity.
- In modern foundry practice, sand is typically recycled and reused through many production cycles.
- RFS generally in proportion is different sand-to-metal ratios employed in different casting processes and products.
- It is important to segregate sand streams at the foundry as each stream can have different characteristics.
- Additionally, some sand is typically unrecoverable during the “shake out” and finishing processes.
- These sands may be contaminated with metal and/or very large chunks of burned cores (referred to as core “butts”)
- And these will need to undergo some type of segregation, crushing and screening before recycling.

4.5 Recyclability of Molding Sand

Table 6.5. 7 Recyclability of Molding Sand

4.6 Beneficial Reuse of RFS

Type of Molding Sand	2. Recyclability	Environmental Impact
Green Sand	95% of molding sand is at least 3~5 times recyclable	Can apply for some sort of raw materials in industries, but also can discharge at landfill mostly without special treatment.
Chemical-Bonded Sand	Some part of Sand can be recyclable depending upon application	Cannot reuse for other raw materials in industries nor directly discharge at landfill. Required with thermal treatment depending on the chemical concentration
Resin Mold Sand	Cannot be recyclable	Less amount of discharge, but toxic waste Required with thermal treatment

1. The greatest volumes of RFS are currently used in geo-technical applications
   Road bases
   Structural fills
   Embankments
   General fills
   Landfills
2. The high quality of the sand makes this industry byproduct an excellent aggregate for
   manufactured products
   Portland cement
   Flowable fill
   Asphalts
   Concrete products
   In more limited application
   RFS is being used in manufactured soils
   Other agricultural applications

ANNEX 6.7

6.7 The Monitoring Report of the Model Companies

6.7.1 Kemwerke

Table 6.7. 1. Details of Activities Conducted

Date	Activity	Persons/Designation
May 5, 2003	Presented and discussed the Waste Minimization Implementation Progress Monitoring Report submitted last April 14, 2003 Follow-up the status of the remaining WM options not yet implemented by the company and actions taken in the problems divulged by the workers during the in-house seminar workshop last March 26, 2003.	ITDI/DOST Emelda A. Ongo PBE Wini Villanueva Kemwerke, Inc. Ms. Angelita M. Gabuna (Tech. & Prodn. Manager) Mr. Jonathan C. Saloma (Process Engineer) Ms. Evelyn B. Bonavente (Laboratory)
May 13, 2003	Discussed and approved the revised WM action and working plans including the implementation schedule. The WM coordinator was asked to carry out the specific tasks for each option in order to implement effectively the WM options in the plant.	ITDI/DOST Emelda A. Ongo Kemwerke, Inc. Mr. Jonathan C. Saloma (Process Engineer) Ms. Edith Mundia
May 15, 2003	Conducted composite sampling of wastewater. The collected sample was submitted to SGS Laboratory in Makati for analysis. Discussed the progress of the program in terms of costs incurred, savings generated and safety. Brainstorming on how to quantify or qualify savings in some implemented WM options. Submitted waste paper bags to Trans-National Paper Inc. in Pasig to examine the possibility of reusing the waste paper bag.	ITDI/DOST Emelda A. Ongo PBE Wini Villanueva Kemwerke, Inc. Ms. Angelita M. Gabuna (Tech. & Prodn. Manager) Mr. Jonathan C. Saloma (Process Engineer) Ms. Evelyn B. Bonavente (Laboratory)

6.7.2 Noah's Paper Mills, Inc.

Table 6.7. 2Detail activities at Noah's No.1

Date	Activity	Persons/Designation
March 04, 2003 (Tuesday)	Company's waste minimization options were presented and other project activities were discussed; notice of commitment of company to the waste min project submitted to company for approval	WM PBE & ITDI staff, NPMI staff
March 24, 2003 (Monday)	Seminar was conducted; composition of NPMI WM team was organized; additional data were gathered and discussions were made on problems encountered; there was an exchange of information on status of implementation of waste minimization project; minutes of company meeting in relation to the waste min project was submitted to WM Team	PBE Staff: Ms. Wini Villanueva Environmental Division,ITDI Staff Dr. Christopher M. Silverio/Chief, Ms. Suzita S. Oredina/ Supervising Sci.Res. Specialist Ms. Belinda A. Villanueva/ Sr.Sci.Res. Spec. NPMI Staff Geronima T. Domingo/ In-House WM Coordinator
April 10, 2003 (Thursday)	Workshop (Implementation of options and problems encountered were further discussed)	Attended by 12 NPMI staff
	Tour of facility The actual process operation and spillages and leaks in some of the production units were observed during the facility walkthrough. High generation of waste sludge during pulping and coarse screening was likewise noted.	PBE,ITDI,Ms. Domingo and NPMI staff
	There was an exchange of information on the status of implementation of waste minimization project and discussions were made on problems encountered; progress monitoring reports were submitted to company for confirmation; minutes of company meeting in relation to the project was submitted to the WM team	Environmental Division,ITDI Staff Ms. Belinda A. Villanueva/ Sr. Sci. Res. Spec. NPMI Staff: Geronima T. Domingo/Tech. Services Manager Edgar Borja/Process Engr.

Table 6.7. 3Detail activities at Noah's No.2

Date	Activity	Persons/Designation
April 28, 2003 (Monday)	Discussions were made on problems encountered and implementation of waste minimization options were monitored; progress monitoring report, action plan, work plan and monitoring checklist were submitted to company for confirmation and approval; minutes of company meeting in relation to the project was submitted to the WM team	PBE: Ms. Wini Villanueva Environmental Division, ITDI Staff Ms. Belinda A. Villanueva/ Sr. Sci. Res. Spec. NPMI Staff: Geronima T. Domingo/Tech. Services Manager

Table 6.7. 4Detail activities at Noah's No.3

Date	Activity	Persons/Designation
April 28, 2003 (Monday)	Discussions were made on problems encountered and implementation of waste minimization options were monitored; progress monitoring report, action plan, work plan and monitoring checklist were submitted to company for confirmation and approval; minutes of company meeting in relation to the project was submitted to the WM team	PBE Ms. Wini Villanueva Environmental Division,ITDI Ms. Belinda A. Villanueva/ Sr. Sci. Res. Spec. NPMI Ms. Geronima T. Domingo/ Technical Services Manager
May 15, 2003 (Thursday)	The following activities were undertaken during the visit: Implementation of waste minimization options by the company were monitored and discussed; Sampling of wastewater was conducted for BOD, COD, TDS and TSS analysis. Composite samples of 500 mL were collected after every hour for 8 hours from the waste outfall. 2.5 liters of pooled sample was brought to SGS Phils. Inc. for analysis. Facility walkthrough of the company's production line was done to further observe the other sources of wastewater and the progress on the operation as a result of the option implementation.	Environmental Division, ITDI Ms. Belinda A. Villanueva/ Sr. Sci. Res. Specialist NPMI Ms. Geronima T.Domingo/ Technical Services Manager

6.7.3 TSB Enterprise

Table 6.7. 5. Detail activities TSB No.1

DATE	ACTIVITY	PERSONS/ DESIGNATION
April 29, 2003	1. Dr. Silverio and Ms. De Guzman together with the In-house WM team members had finalized the TSB Enterprises Waste Minimization Action Plan and the TSB Enterprises Waste Minimization Schedule. These two documents were signed by Ms. De Guzman, TSB Marketing Manager, during the site visit. 2. The various options were again reviewed during the meeting. Some options were removed for implementation due to overlapping in their implementation with other options. Other options were modified and simplified due to financial constraints. 3. The in-house team was asked to estimate the amount of peels collected weekly by a private contractor. Accordingly, 2.5 tons of peels are collected either once or thrice a week. At lower production rate, 2.5 tons of peels are collected every week, on the other hand, a total of 7.5 tons of peels are collected three times a week at 2.5 tons per collection during a high production operation. To validate this estimate, the in-house team will conduct an actual sampling and weighing of peels prior to collection. This will be reported during the next meeting. 4. The amount of water consumed per unit of production was also calculated during the meeting. It was estimated that about 11.8 liters of water is consumed per kilogram of product produced. 5. Following are the final WM options to be implemented by the company: 6. Peeling Section o Segregation and sorting of peels. o Fruit peels shall be used as substrate for composting. 7. Slicing/Cubing Section o Continuous practice of removing solids on the floor prior to washing with high nozzle spray. o Re-use of water with anti-bacteria from 2nd rinsing of raw materials in cleaning working areas. o Re-use of water from 2nd rinsing of raw material for cleaning of another batch of raw materials 8 Fruit Washing Section o Determine volume of water consumed. o Water in the 2nd washing fruits will be used in the 1st washing of new fruits	1 Dr. Christopher M. Silverio, ITDI-DOST team leader 2 Ms. Ma. Bernadita de Guzman, in-house team coordinator 3 In-house WM team members

DATE	ACTIVITY	PERSONS/ DESIGNATION
	before water is discharged. o Used water will be used for cleaning the working areas. 9 Cooling Section o Maintain cleanliness of cooling water and tub to minimize frequency of discharge by rinsing of pails before placing in cooling tub, tight sealing of product to avoid spillage, installation of filter cloth and removal of floating material using nylon net. o Install water meter for usage monitoring and control. 10 Pails and Crates Washing Section o Implement correct pail washing procedure by: ❑ Using the existing rinsing (banlaw) drum for first and second washing. ❑ The drums shall be reduced by half a size to lessen the amount of water use inside. ❑ The sanitized tub water will be used for the 1st drum containing soap and water; 1st and 2nd banlaw water shall not be discharged but be used for the next day. ❑ Sanitized tub water shall also be used in cleaning the washing area. **Solid Wastes** ❑ Peels and organic materials generated will be composted. ❑ Practice sorting and segregation of biodegradable, non-biodegradable and recyclable materials. **Water Supply System** ❑ Re-piping of company's water system in such a way that reverse osmosis (RO) water will be only used in the production area.	
May 16, 2003	1 During one of our meetings with the National Solid Wastes Management Commission (NSWMC), one of the topics that was brought out is the MOU signed between Starbuck Coffee, DENR and MAPECON on the utilization of ground coffee solid waste as substrate for the production of green charcoal. Dr. Silverio, as a DOST alternate member of NSWC, raised the problem of solid waste disposal of TSB and the possibility of using it by MAPECON as material for green charcoal making. MAPECON has a prior agreement with DENR to set up an operating plant for charcoal making within the DENR compound. This project is in need of about 3 tons of biodegradable material for its daily operation and Starbuck could not meet the	1 Dr. Christopher M. Silverio, ITDI-DOST team leader 2 Ms. Ma. Bernadita de Guzman, in-house team coordinator 3 In-house WM team members

DATE	ACTIVITY	PERSONS/ DESIGNATION
	required volume. 2 Mr. Jun Catan, CEO of MAPECON and producer of green charcoal, was invited to attend the meeting at TSB last May 16 to discuss the possibility of utilizing fruit peels for green charcoal making. However, due to some previous commitment he delegated instead Ms. Bianca C. Atienza, his granddaughter, to attend the meeting. During the meeting, we discussed the various requirements involved in the production of green charcoal which is the following: 1) 3 tons of biodegradable material are needed every day for the operation; 2) all types of cellulosic materials (peels, seeds, kitchen wastes, etc.); 3) site is accessible to facilitate hauling and processing; and, 4) free raw material. TSB could provide 8.5 tons per week with the agreement that hauling will be done by MAPECON on site. With this arrangement, TSB will be able to save from its disposal and hauling cost by P1,300.00 per week. 3 The team had also discussed the volumes of water used in each production section in line with the various options formulated. With the data provided by the in-house team about the amount of water use for washing of fruits, cleaning of pails and crates, cooling of product, and cleaning of floors, the volume of water save was computed when the options are implemented. 4 The in-house team has also provided the implementation cost of some of the options, such as: use of high pressure water nozzle spray in the removal of solids on the floor; and enclosure of the cooling section. 5 During the meeting there are some minor revisions that were made on the options. 6 The team has also conducted a facility walkthrough to observe the entire process operation and to look at other possible sources of wastewater not included in the option. In the pulping section, it was observed that water is continuously running even when the 20 liter capacity pail is already filled up. With a timer, we measure the time that one pail is filled up and it was about 10 minutes or 2 liters/min. Computing on a daily basis, about 1.2 m^3 is wastage per day per pail. The no cost option is for the operator to regularly watch the pails during the filling process and turned the faucet off when it is already filled up.	

Table 6.7. 6. Detail activities at TSB No.2

DATE	ACTIVITY	PERSONS/ DESIGNATION
May 30, 2003	1 The in-house team and the DOST expert continued to formulate options that will further reduce water consumption in the fruit preparation section/production area. Three (3) additional options were formulated: o Installation of a release valve in the pulping machine to reduce spillage of mango puree in the floor. o Installation of garden hose sprays use in cleaning the floor to reduce water usage in cleaning puree spills. o Use of high pressure water nozzle spray in cleaning the cooking and pulping equipment. 2 After the meeting, a facility walkthrough was again initiated by the DOST team to observe the use of pulping and cooking equipment and water hoses during the production period. 3 The team also wants to validate whether the 3 new options could be implemented.	1 Dr. Christopher M. Silverio, ITDI-DOST team leader 2 Ms. Ma. Bernadita de Guzman, in-house team coordinator 3 In-house WM team members
June 6, 2003	1 The team discussed whether the additional options formulated last May 30 were implemented. Accordingly, the option, which involves the installation of a release valve in the pulping equipment, was not implemented because of some operational problem regarding the rapid discharge of puree in the two outlets of the pulping equipment. The operator needs to continuously discharge the puree into the container without any interruption.. 2 During the visit, the hoses used for cleaning the equipment and floors were already provided with gun sprayers. Likewise, after the 8 hours of operation, the equipment and floors were likewise washed and cleaned using hose with high pressure nozzle spray instead with ordinary water pails or hoses. 3 A facility walkthrough was again conducted to observe whether the options are fully implemented in the various sections of the production area. 4 In the presence of a private consultant, the team discussed the appropriate wastewater treatment systems that will be constructed by the company. Equalization tank, activated sludge system and sedimentation process are the systems that were identified by the team and the consultant that could be adopted by TSB. It was also agreed that a study on the re-channeling of the waste stream will be conducted first prior to the setting up of the WTF. 5 The teams also discussed the presentation that will be made during the forthcoming closure workshop.	1 Dr. Christopher M. Silverio, ITDI-DOST team leader 2 Ms. Ma. Bernadita de Guzman, in-house team coordinator 3 In-house WM team members

6.7.4 Acetech Metalcasting Manufacturing, Inc.

Table 6.7. 7.Detail activities at Acetech No.1

Date	Activity	Persons/Designation
April 29, 2003	Reviewed and revised the WM Implementation Schedule Observation of the melting, casting, shake out operations and air emission Testing of the pH of the slag Monitoring of waste sand collected from shot blast machine and sand recovered from conveyor spills and reused Monitored the recovery of metals from sand by magnet Contacted other laboratories for the air emission test and chemical analysis of slag	Suzita S. Oredina, Expert Napoleon Tanganco, WM Team Coordinator
May 13, 2003	Submitted 2 slag samples for chemical analysis Revised the WM Implementation Schedule Arranged for the air emission test with laboratory and Acetech Inspected the access to stack for air emission test Constructed a platform and extended the chimney of cupola for the stack emission test Monitored the recovery of sand before sand blasting Monitored the reduction of limestone charged to the cupola	Napoleon Tanganco, WM Team Coordinator Suzita S. Oredina, Expert

II. Main Milestones/Achievements of the Company this Month

Milestones **Implementation of Waste Minimization Options**	**Achievements**
Recovery and reuse of sand spilled from conveyors	Recovered 60 kg of sand spilled from conveyors per cycle Savings = 60 kg sand/cycle x 75 cycles/year x P1.90/kg = P 8,550.00/year
Recovery of sand from shot blast machine	Recovered 50 kg sand per week Savings = 50 kg/week x 50 weeks/year x P1.90/kg = P 4,750.00/year
Recovery of sand before sand blasting	Recovered and reused 1.5 tons sand/cycle Savings = 1,500 kg/cycle x 75 cycles/year x P1.90/kg = P 213,750.00/year
Metal recovery from sand	Cost for purchase of magnet = P4,800.00 Recovered 30 kg metal/4-day cycle Savings = 30 kg metal/cycle x 75 cycles/year x P8.00/kg metal = P 18,000.00/year
Improve melting quality	Tested the pH of the black and greenish colored slag to determine the changes in material charge. The greenish colored slag indicates a better quality melt. Results of pH tests: Black slag = pH 9.6 Greenish slag = pH 8.8 Based on the results of the pH test, the amount of limestone charge was reduced by one (1) kg/charge to shift the pH towards the greenish slag. The flow of the metal and slag improved. Savings = 1 kg/charge x 35 charges/cycle x 75 cycles/year x P 0.80/kg limestone = P 2,100.00/year

ANNEX 6.8

WASTE MANAGEMENT GUIDEBOOK

with Best Practices in Chemical, Food Processing, Foundry and Pulp & Paper Industries

June 2003

JICA Japan International Cooperation Agency

PBE Philippine Business for the Environment

ITDI-DOST

ENVIRONMENTAL MANAGEMENT WITH PUBLIC AND PRIVATE SECTOR OWNERSHIP IN THE PHILIPPINES (EMPOWER)

IN COOPERATION WITH

PHILEXPORT

PULPAPEL

SPIK

MESSAGE

I wish to commend the great partnership shared by the industry sector, non-government institutions and the government to successfully develop this Waste Minimization Guidebook.

I wish to extend as well my wholehearted gratitude to the four (4) model companies from the pulp and paper, chemicals, metal casting and food processing sectors, with the full support of their respective industry associations, who have spent valuable resources to make this Waste Minimization efforts under the stewardship of JICA, PBE, DOST and BOI a success.

I therefore invite everyone to read this Guidebook and be inspired by the progress and achievements of these model companies not only in the field of waste minimization but also on environmental management as a whole. I am most certain that the Guidebook can be the beginning of better opportunities, especially for the small and medium enterprises which – though limited in resources – can become responsible corporate citizens and embark on environmental management efforts.

We are encouraged by these collaborative efforts in building the foundation for an optimal environmental performance by industries.

I wish everyone success in pursuing a stronger private – public sector partnership to build a happier and healthier environment for the Filipino people.

GREGORY L. DOMINGO
DTI Undersecretary and
BOI Vice – Chairman and Managing Head

MESSAGES FROM PARTNER INDUSTRY ASSOCIATIONS

PULP AND PAPER MANUFACTURERS ASSOCIATION
George S. Chua, President

Greetings! On behalf of the members of the Pulp and Paper Manufacturers Association of the Philippines (PULPAPEL), we would like to extend our congratulations to the JICA-assisted Environmental Management with Public and Private Sector Ownership of the Philippines (EMPOWER) Project of the Board of Investments (BOI), for coming up with a Waste Minimization Guidebook under its Waste Minimization Pilot Project. We are also fully supporting the efforts of the Philippine Business for the Environment (PBE), which has been tasked with the development of the Waste Minimization Guidebook.

Our association has been a long time advocate of waste minimization and environmental responsibility and has been an active partner of the Department of Environment and Natural Resources. Almost all of our paper and paper-based production are manufactured from 100% recycled paper, providing Filipinos with an incentive to segregate their waste and supporting the DENR's Solid Waste Management Program, which will reduce the volume of garbage. With an ongoing recycling program spearheaded by the DENR, this Waste Minimization Guidebook is a timely supplement.

Thank you for giving us the opportunity to be a part of this endeavor and we look forward to the continuing collaboration between all private and government agencies that are working towards a greener Philippines. Mabuhay tayong lahat!

CHEMICAL INDUSTRIES ASSOCIATION OF THE PHILIPPINES
Juanito M. Mantaring, Jr., President

The Responsible Care Council of the Samahan sa Pilipinas ng mga Industriyang Kimika (SPIK) congratulates the Environmental Management with Public and Private Sector Ownership (EMPOWER) Project of the Board of Investments (BOI) in its publication of this Waste Minimization Guidebook. As a "partner" in this project, SPIK looks forward to the guidebook's use in echoing to its members previous seminars and workshops developed for the promotion of waste minimization nationwide.

Responsible Care covers 6 codes of management practices in its initiatives, namely: Process Safety; Employee Health and Safety; Pollution Prevention; Distribution; Product Stewardship and Community Awareness; and Emergency Response.

It is obvious that Waste Minimization plays importance in more than just our Pollution Prevention code, as it will be in the promotion of RC with the community-at-large, the addressee of last code. Best practices of EMPOWER participating companies and industry associations shared in the guidebook will serve as our models in this effort.

I also take this opportunity to congratulate our SPIK/RD member company KEMWERKE, INC., for having been chosen to be assisted by the project as the model for the chemical industry.

PHILIPPINE EXPORTERS CONFEDERATION
Sergio R. Ortiz-Luis, President

We welcome with enthusiasm the efforts put by the Philippine Business for the Environment (PBE) and the Environmental Management with Public and Private Sector Ownership (EMPOWER) Project of the Board of Investments for finally coming out with a practical guidebook on waste minimization.

The project is another bold and positive step at evolving a working partnership between government agencies and business enterprises at restoring a healthier and cleaner environment in the country. It comes on the heels of another major decision made by the Environmental Management Bureau (EMB), that of setting up a system of rapidly granting exemptions to small and medium enterprises not required to get Environment Clearance Certificates.

The business community is as aware as other segments in society of the urgent need to keep industrial wastes at the minimum so as not to poison the air, our waterways and our lands. Instead of getting threatened with closures, these enterprises welcome the help of government for them to learn how to adopt the best waste management practices.

The Waste Minimization Guidebook will surely be an effective means of reaching out to SMEs that make up most of business in the country. With a guidebook in their hands, those in the chemical, food processing, foundry and paper industries will have a waste management roadmap to follow.

For it to have a positive impact at keeping our land fit to live in, the guidebook must be given the widest circulation in the ranks of the country's businessmen.

PHILIPPINE METALCASTING ASSOCIATION INC.
Jerry Hui, President

The Philippine Metalcasting Association Inc. (PMAI) extends its felicitations to the Philippine Business for the Environment (PBE) for coming out with a Waste Minimization Guidebook for our metalcasting (foundry) industry. This was accomplished through the cooperative efforts of the involved industries – chemical, food processing, foundry and pulp & paper – with the PBE.

We now have an authoritative rulebook to eliminate any guesswork in our relationship with our environment and thereby improve this. Ecology dictates that this relationship should be preserved for our own preservation.

Congratulations and good luck!

FOREWORD

This Guidebook on Waste Minimization is a product of the Waste Minimization Pilot Project (WMPP) of the Environmental Management with Public and Private Sector Ownership (EMPOWER) Project of the Philippines implemented by the Board of Investments and the Philippine Business for the Environment with funding from the Japan International Cooperation Agency (JICA). The WMPP helped selected industries to successfully implement waste minimization programs in model companies, whose experiences subsequently became the basis for this Guidebook.

The Guidebook thus documents actual waste minimization efforts. It is intended for the use of industry associations, company decision-makers, plant managers and supervisors. It is also useful for government agencies that work with industries to adopt waste minimization and which support voluntary industrial environmental management to increase productivity and competitiveness, particularly of small and medium enterprise.

It begins with an overview of waste minimization concepts and benefits. It contains a section on Waste Assessment and Planning. It also describes General Waste Minimization Techniques and their specific applications and benefits to four industry sectors represented by model companies which received training and on-site assistance for waste minimization under the EMPOWER-WMPP. These sectors are Food processing, Foundries, Pulp and paper, and Chemicals.

Several industry association partners have played key roles in the EMPOWER-WMPP and in the development of this guidebook. They commit to continuing advocacy among their members through industry/sector-wide WM action plans and training efforts, with the help of this Guidebook. They are as follows:

- ❑ Philippine Metalcasting Association, Inc. (PMAI),
- ❑ Philippine Exporters Confederation, Inc. (PHILEXPORT) National
- ❑ PHILEXPORT - Cebu City
- ❑ Pulp and Paper Manufacturers Association, Inc. (PULPAPEL), and
- ❑ Chemical Industries Association of the Philippines or SPIK.

The Guidebook also introduces other EM approaches such as environmental cost accounting (ECA), greening the supply chain management (GSCM), environmental management system, life cycle analysis, and ecolabelling.

In the final analysis, companies and industry associations should recognize that this Guidebook is only a tool for those who are genuinely committed to reduce waste and prepared to invest the manpower, time, effort and resources needed. Waste reduction should be viewed as a frame of mind, rather, than just a quick-fix technique. There are no easy solutions, but the rewards – both economic and environmental – are well worth it, in the end.

LISA C. ANTONIO
Executive Director
Philippine Business for the Environment and
EMPOWER – WMPP Program Director

ACKNOWLEDGEMENTS

Several individuals who made valuable contributions to the preparation of the EMPOWER Waste Minimization Guidebook are acknowledged below, as follows:

JICA Study Team

- Masato Ohno (Team Leader)
- Tad Tanaka
- Kaoru Oka
- Masanao Hirai
- Hiroshi Uchiyama
- Norio Sambyakugari
- Misako Takagi
- Ryugi Ogawa

Industrial Technology Development Institute

- Dr. Christopher M. Silverio (Team Leader)
- Suzita S. Oredina
- Emelda A. Ongo
- Carmel C. Gacho
- Belinda A. Villanueva

Philippine Business for the Environment Project Team

- Lisa C. Antonio (WMPP Program Director)
- Lloly Y. De Jesus (WMPP Project Manager and Guidebook Writer)
- Wilhelmina Y. Villanueva (WMPP Project Coordinator)

Other Members of the WMPP Technical Working Group

- Linda Arcellana, OIC – Director, Industrial Policy Division, BOI
- Raquel Echague, OIC – Environmental Matters Division, BOI
- Hermes Bautista, Philippine Metalcasting Association, Inc. (PMAI)
- Napoleon Tangangco, Philippine Metalcasting Association, Inc. (PMAI)
- Leonor Abella, Philippine Exporters Confederation, Inc. (PHILEXPORT – National)
- Victor Pascual, Pulp and Paper Manufacturers Association, Inc. (PULPAPEL)
- Rey Gomez, Pulp and Paper Manufacturers Association, Inc. (PULPAPEL)
- Teresita Corpuz, Chemical Industries Association of the Philippines or SPIK
- Allan Suarez, Philippine Exporters Confederation, Inc. (PHILEXPORT – National)

MODEL COMPANIES

Kemwerke Incorporated

- Luis Fernando, President
- Angelita Magaya-Gabuna, Technical & Production Manager

TSB Enterprises, Inc.

- Tommy Romualdo, President
- Ma. Bernardita De Guzman, Marketing Manager

Acetech Metal Industries Corporation

- Napoleon Tanganco, Vice President
- Hermes Bautista, Technical Consultant

Noah's Paper Mills Inc.

- David Hwang, Vice President
- Geronima Domingo, Technical Services Manager

Everyone's efforts are sincerely appreciated because this Guidebook will benefit not only the participants of the EMPOWER – WMPP but also continue to benefit future industry users in general.

Contents

List of Tables

List of Figures

GLOSSARY

Biochemical Oxygen Demand (BOD) - measure of amount of oxygen needed by microorganisms in the degradation of organic matter.

Catalyst - any substance that affects the rate of reaction without itself taking part in that reaction.

Chemical Oxygen Demand (COD) - the oxygen equivalent of oxidizing organic matter by the use of a strong chemical reagent in acidic medium.

Class C Waters - 1) Fishery Water for the propagation and growth of fish and other aquatic resources; 2) Recreational Water Class II (boating, etc.); 3) Industrial Water Supply Class I (for manufacturing processes after treatment).

Class D Waters - 1) For agriculture, irrigation, livestock watering, etc.; 2) Industrial Water Supply Class II (such as cooling, and others); 3) Other inland waters, by their quality, belong to this classification.

Class SB (Coastal and Marine Waters) - 1) Recreational Water Class I (areas regularly used by the public for bathing, swimming, skin diving, and others); 2) Fishery Water Class I (spawning areas for *Chanos chanos* or “Bangus” and similar species).

Class SC (Coastal and Marine Waters) - 1) Recreational Water Class II (such as boating, and others); 2) Fishery Water Class II (commercial and sustenance fishing); 3) Marshy and/or mangrove areas declared as fish and wildlife and sanctuaries.

Class SD (Coastal and Marine Waters) - 1) Industrial Water Supply Class II (such as cooling, and others); 2) Other coastal and marine waters, by their quality, belong to this qualification.

Discharge: Outflow; the flow of a stream, canal, or aquifer. One may also speak of the discharge of a canal or stream into a lake, river, or ocean. (Hydraulics) Rate of flow, specifically fluid flow; a volume of fluid passing a point per unit of time, commonly expressed as cubic feet per second, cubic meters per second, gallons per minute, gallons per day, or millions of gallons per day. (Washington Department of Ecology, 1992)

Cleaner Production (CP)- (as defined by UNEP) the continuous application of an integrated preventive environmental strategy to processes, products, and services to increase efficiency and reduce risks to human and the environment.

Effluent: Solid, liquid, or gaseous wastes that enter the environment as a by-product of man-oriented processes (Soil Conservation Society of America, 1982).

EPA: United States Environmental Protection Agency.

Environmental Management System (EMS) - (defined by ISO 14001 standard) refers to the organizational structure, responsibilities, practices, procedures, processes, and resources for developing, implementing, achieving, reviewing, and maintaining the environmental policy.

Heavy metals: Metallic elements with high atomic weights, e.g., mercury, chromium, cadmium, arsenic, and lead. They can damage living things at low concentrations and tend to accumulate in the food chain

Incineration: The controlled process by which solids, liquid, or gaseous combustible wastes are burned and changed into gases; the residue produced contains little or no combustible material (Soil Conservation Society of America, 1982).

ISO 14001 - specifies the framework for the management system that allows an organization to meet its environmental obligations reliably and consistently.

Lagoon: A reservoir or pond built to contain water and animal wastes until they can be decomposed either by aerobic or anaerobic action

Leachate: Liquids that have percolated through a soil and that contain substances in solution or suspension

Load: The quantity (i.e., mass) of a material that enters a waterbody over a given time interval

pH - an indication of the acidity or alkalinity of a substance.

Pollutants – (as defined by R.A. 3931) means any substance whether solid, liquid or gaseous which directly or indirectly: 1) alter the quality of any segment of the receiving environment so as to affect or tend to affect adversely any beneficial use there of; 2) is hazardous or potentially hazardous to health; 3) imparts objectionable odor, noise, temperature change in physical, chemical or biological change to any segment of the environment; or 4) is in excess of the allowable limits or concentration or quality standards specified, or in contravention of the condition, limitation or restriction prescribed in the permit issued by the commission.

Pollution – (as defined by R.A. 3931) means any alteration of the physical, chemical and biological properties of any water, air and/or land resources of the Philippines, or any discharge there to of any liquid, gaseous or solid wastes, or any production of unnecessary noise, or any emission of objectionable odor, as will or is likely to create or to render such water, air and/or land resources harmful, detrimental or injurious to public health, safety or welfare, or which will adversely affect their utilization for domestic, industrial, agricultural, recreational, or other legitimate purposes.

Settleable Solids - solids that readily settles due to its density.

Sizes - refers to the chemical mixtures applied to yarns to improve its strength and bending behavior thus preventing it from breaking during weaving operations .

Slivers - sheets of carded fibers that look like loose rope-like strands.

Sludge: The material resulting from chemical treatment of water, coagulation, or sedimentation

Surfactants – surface-active and methylene blue-active substances that are slightly soluble in water.

Total Dissolved Solids (TDS) - the total amount of minerals, organic matter, and nutrients that are dissolved in the water.

Total Suspended Solids (TSS)- solids in water that can be trapped by a filter with pore size 0.45 micrometer.

Waste: Material that has no original value or no value for the ordinary or main purpose of manufacture or use; damaged or defective articles of manufacture; or superfluous or rejected matter or refuse

Weir: Device for measuring or regulating the flow of water

Waste Minimization - refers to the reducing, to the extent possible, the amount of any waste that is generated or subsequently treated, stored, or disposed of

ACRONYMS

BOD	-	Biochemical Oxygen Demand
BOI	-	Board of Investments
BPEM	-	Best Practice Environmental Management
BPS	-	Bureau of Product Standards
CAC	-	Command and Control
CCO	-	Chemical Control Order
COD	-	Chemical Oxygen Demand
DAO	-	DENR Administrative Order
DENR	-	Department of Environment and Natural Resources
DILG	-	Department of Interior and Local Government
DTI	-	Department of Trade and Industry
DO	-	Dissolved Oxygen
ECA	-	Environmentally Critical Area
ECC	-	Environmental Compliance Certificate
ECP	-	Environmentally Critical Project
EIS	-	Environmental Impact Statement
EMPOWER	-	Environmental Management with Public and Private Sector Ownership
EMS	-	Environmental Management System
EUF	-	Environmental User Fee
FOG	-	Fats Oil and Grease
IEE	-	Initial Environmental Examination
ITDI	-	Industrial Technology Development Institute
LGU	-	Local Government Unit
LLDA	-	Laguna Lake Development Authority
MSDS	-	Materials Safety Data Sheet
NGO	-	Non-Government Organization
NPCC	-	National Pollution Control Commission
PCB	-	Polychlorinated Biphenyls
PCF	-	Pollution Control Facilities
PCL	-	Priority Chemical List
PNS	-	Philippine National Standards
PULPAPEL	-	Pulp and Paper Manufacturers Association, Inc
PHILEXPORT	-	Philippine Exporters Confederation, Inc.
SPIK	-	Samahan sa Pilipinas ng Industriyan Kimika
SWM	-	Solid Waste Management
TOC	-	Total Organic Carbon
VOC	-	Volatile Organic Compounds
WM	-	Waste minimization

1.0 Introduction

Waste Minimization (WM) is a simple concept. It means reducing wastes to reduce costs and this can be done by using resources efficiently, such as water, energy and raw materials. It is evident, however, that there is still apparent hesitation on the part of the industry, which prefers to invest in treatment and disposal rather than on implementing waste minimization, programs in their facilities. Companies need to see actual benefits to be convinced that waste minimization works and this Guidebook aims to demonstrate that, in fact, *"Prevention is better, and usually cheaper, than cure ".*

1.1 Overview of WM History

Before the 1980s, the waste management approach of industry has generally been **"End of Pipe"** or through **"Landfill Disposal"**. End of pipe means that a problem is addressed when it is already there, rather than before it occurs. These approaches do help to reduce environmental problems but there are some limits on how much the environment can be improved by applying these methods. In addition, end-of-pipe and landfill disposal tend to be costly and have no return on investment.

Many countries now have policies that advocate the reduction or elimination of waste generation at the source. At the same time these recognize that some wastes are inevitable and should thus be controlled to reduce present and future threats to human health and the environment, especially hazardous wastes. Such policies emphasize that:

- Pollution should be prevented or reduce at the source whenever feasible.
- Pollution that cannot be prevented should be recycled in an environmental safe manner whenever feasible.
- Pollution that cannot be prevented or recycled should be treated in an environmental safe manner whenever feasible.
- Disposal or other release into the environment should be employed only as a last resort and should be conducted in the environmentally safe manner.

In the Philippines, the history of waste management can be traced back to the time environmental regulations were formulated. Before the 1974 Presidential Decree (PD) 984 or the Pollution Control Act, wastes were indiscriminately disposed everywhere. From the time the 1978 Implementing Rules and Regulations (IRR) of PD 984 were promulgated, industries began investing on pollution control facilities in order to comply. After several years of implementation, the industries realized that although treatment costs were increasing, compliance to the regulations were still unattainable.

By early 1990, many local industries began joining the bandwagon of the international community, and slowly adopted the concept of waste minimization. The Philippine government included the provision of source reduction as the first option in managing hazardous wastes when it promulgated Republic Act 6969 or the Toxic Chemical and Hazardous and Nuclear Wastes Act. The Solid Wastes Management Act or the Republic Act 9003 advocates waste minimization and requires implementing agencies to establish waste recycling programs and infrastructures.

Today, many sectors of Philippine industries have been trying to raise awareness on waste minimization not only due to regulatory pressures but also because of the high cost of doing business and competitive markets. More companies, big and small, are also realizing they have a responsibility to protect the environment because this serves as a natural resource base and also affects the quality of life.

1.2 Waste Minimization and Cleaner Production

Waste minimization is integrated into the concept of **"**Cleaner Production**"** which the United Nations Environment Program (UNEP) defines as

> *the continuous application of an integrated preventive environmental strategy to process, products, and services to increase overall efficiency, and reduce risks to humans and the environment.*

Cleaner Production can be applied to the process used in any industry, to products themselves and to various services provided in society.

UNEP further explains that the key elements of Cleaner Production are categorized as follows:

For production process. Cleaner Production results from one or a combination of process change, improving good housekeeping practices, or optimizing process operating parameters

For products: Cleaner Production aims to reduce the environmental, health and safety impacts of products over their entire life cycles, from raw materials extraction, through manufacturing and use, to the 'ultimate' disposal of the product.

For services: Cleaner Production implies incorporating environmental concerns into designing and delivering services.

Cleaner Production also describes a preventive approach to the environmental management. It is neither a legal nor a scientific definition to be dissected, analyzed or subjected to theoretical disputes. It is a broad term that encompasses what some countries/institutions call "Eco-Efficiency", "Waste Minimization", "Pollution Prevention", or "Green Productivity", but also includes other approaches.

1.3 Background of the Guidebook

Although, there is no specific law governing the adoption of waste minimization, the Philippine government through the Department of Environment and Natural Resources and other agencies like the Board of Investments of the Department of Trade and Industry, has been implementing several programs to encourage the adoption of waste minimization as an effective tool for sustainable waste management.

One such program is the Environmental Management with Public and Private Sector Ownership (EMPOWER) whose goal is to promote voluntary industrial environmental management (IEM) from all industrial sectors and to disseminate the concept of IEM all over the Philippines. This project is a joint undertaking of the BOI-DTI and the Japan International Cooperation Agency (JICA).
One component of EMPOWER is the Waste Minimization Pilot Project (WMPP), which aims to integrate productivity and waste minimization by carrying out waste reduction assessment and planning in four key industry sectors:

- ❑ Food processing
- ❑ Foundries
- ❑ Pulp and paper
- ❑ Chemicals

This Waste Minimization Guidebook aims to provide a sustainability tool for the WMPP by documenting the successful implementation of waste minimization programs of model companies from the above sectors.

This Guidebook is intended for the use of company decision-makers, government agencies with the mandate to encourage industries to adopt waste minimization, local government units, and other advocates of waste minimization.

The Guidebook is organized into the following:

- ❑ Section 2: **Waste Minimization Concept**. Provides an overview of waste management principles and waste minimization as an integral component of IEM and illustrates documented barriers and benefits of waste minimization.

- ❑ Section 3: **Waste Minimization and Productivity Improvement**. Presents the various techniques in minimizing wastes that can be applied to industrial settings. Added value includes basic profile of the industry sectors. It also describes various tools for identifying WM and productivity improvement .

- ❑ Section 4 :**Waste Minimization Success Stories** – Documents successful waste minimization efforts of model companies from four industry sectors.

- Section 5: **Other Environmental Management Approaches**. Provides an overview of other approaches that industries can pursue to supplement their WM Program.

2.0 Waste Minimization Concept

All activities of an organization or operations of a company produce waste! The term "waste minimization" applies to measures that reduce the volume and toxicity of waste generated. It is more desirable to reduce waste at source, that is, where it happens. Recycling and reuse are the next alternatives. Waste treatment and disposal, however, are also important because they ensure that wastes which cannot be minimized, are treated and disposed of properly. Treatment technologies like incineration are less desirable because although they decrease waste volume, they can increase toxicity.

2.1 Waste Management Hierarchy

Figure 1 describes four elements of the waste management hierarchy, namely: (1) source reduction, (2) recycling, (3) treatment, and (4) disposal. Only source reduction and recycling provide true waste minimization opportunities. These minimize risks to human health and the environment.

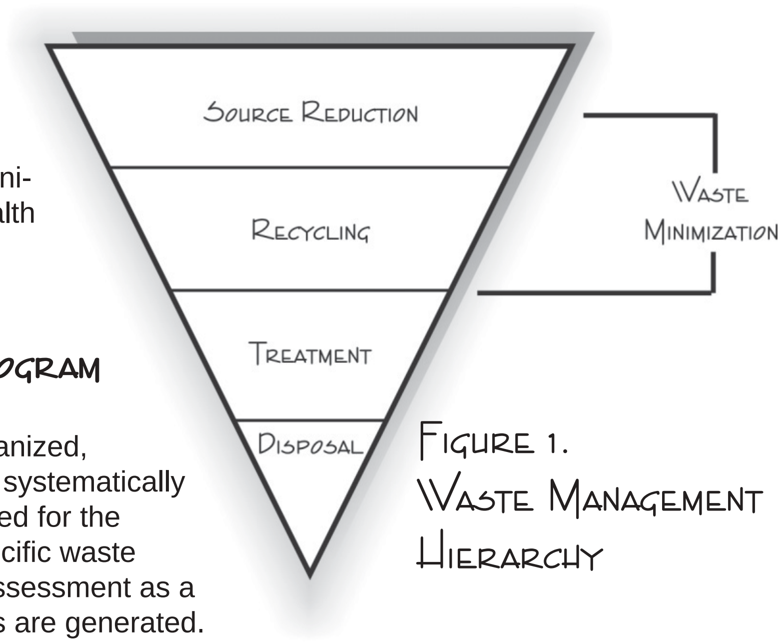


Figure 1. Waste Management Hierarchy

2.2 Waste Minimization Program

A waste minimization program is an organized, comprehensive and continuous effort to systematically reduce waste generation. It is established for the organization as a whole. It includes specific waste minimization projects and uses waste assessment as a tool to determine where and how wastes are generated.

The waste minimization program reflects the goals and policies set by the management of an organization. It should also be an ongoing effort and should strive to make waste minimization part of the company's overall philosophy. While the main goal is to reduce or eliminate wastes, it may also bring about an improvement in the company's production efficiency.

2.2.1 WM Program Elements

For a waste minimization program to be successful, the following elements should be present:

Top management support. – There should be a formal policy statement or directive to implement measures identified through waste minimization assessments. Management should invest the necessary time and money to make the waste minimization program work

Clear scope and objectives – There should be qualitative and quantitative goals for success, such as incorporating waste minimization into company policy or reducing waste by 40 percent in 5 years. Such goals guide the waste assessment process because they give specific direction to what the company wants to accomplish

Elements of a Waste Minimization Program

- Top Management Support
- Clear scope and objectives
- Employee involvement

Employee involvement - Employees should be asked to identify opportunities for changes in procedures or manufacturing processes that will help to minimize waste. This makes them feel involved and more responsible for implementing waste minimization measures.

2.3 Incentives of Waste Minimization

Many companies have successfully implemented waste minimization. Some of the benefits that these companies attain include:

- **Save money** by reducing waste treatment and disposal costs and raw material purchases and other operating costs
- **Meet** national waste minimization **policy goals**
- **Reduce** potential environmental **liabilities**
- Protect public health and worker **health and safety**
- Protect the **environment**

" Less waste means less cost!"

2.4 Barriers to Waste Minimization

Just as there are many incentives to waste minimization, there are also barriers to its implementation. The most common barrier is our discomfort with change. Companies believe change should be made only if there is a specific problem. Some companies fear that attempts at waste minimization will fail. Others do not think the environment is their responsibility. Some of these barriers include:

- Fear that production changes will lower the quality of their product
- Changes in processes will make the company less efficient, especially because workers must learn new processes.
- New operating processes may reduce waste but create bottlenecks that decrease the production rate

- Product changes may not be acceptable to customers, thus creating the need to spend additional time on marketing and advertising
- Inventory reduction programs may lead to stockouts during periods of high product demand
- Some waste minimization programs require new equipment or technology, and companies may not have the funds available to purchase such equipment or may not be comfortable trying out new technologies

Although there are many barriers to implementing waste minimization, the benefits or incentives can outweigh the barriers or obstacles.

Properly educating and including all employees, as well as customer and suppliers, about the advantages and stages of waste minimization program, can achieve successful projects and programs.

2.5 Waste Assessment

Before starting a Waste Minimization Program, a company should first do a Waste Assessment. This is a systematic, planned procedure with the objective of identifying ways to reduce or eliminate waste.

Figure 2 illustrates the steps in performing waste assessment.

STEP ONE. Get Management Commitment.

The first step in planning and organizing a waste minimization assessment is to get management commitment, preferably in the form of a written declaration or formal policy. This is vital to a successful waste minimization program. Management should believe that the benefits of a waste minimization program outweigh the costs.

STEP TWO. Plan and Organize

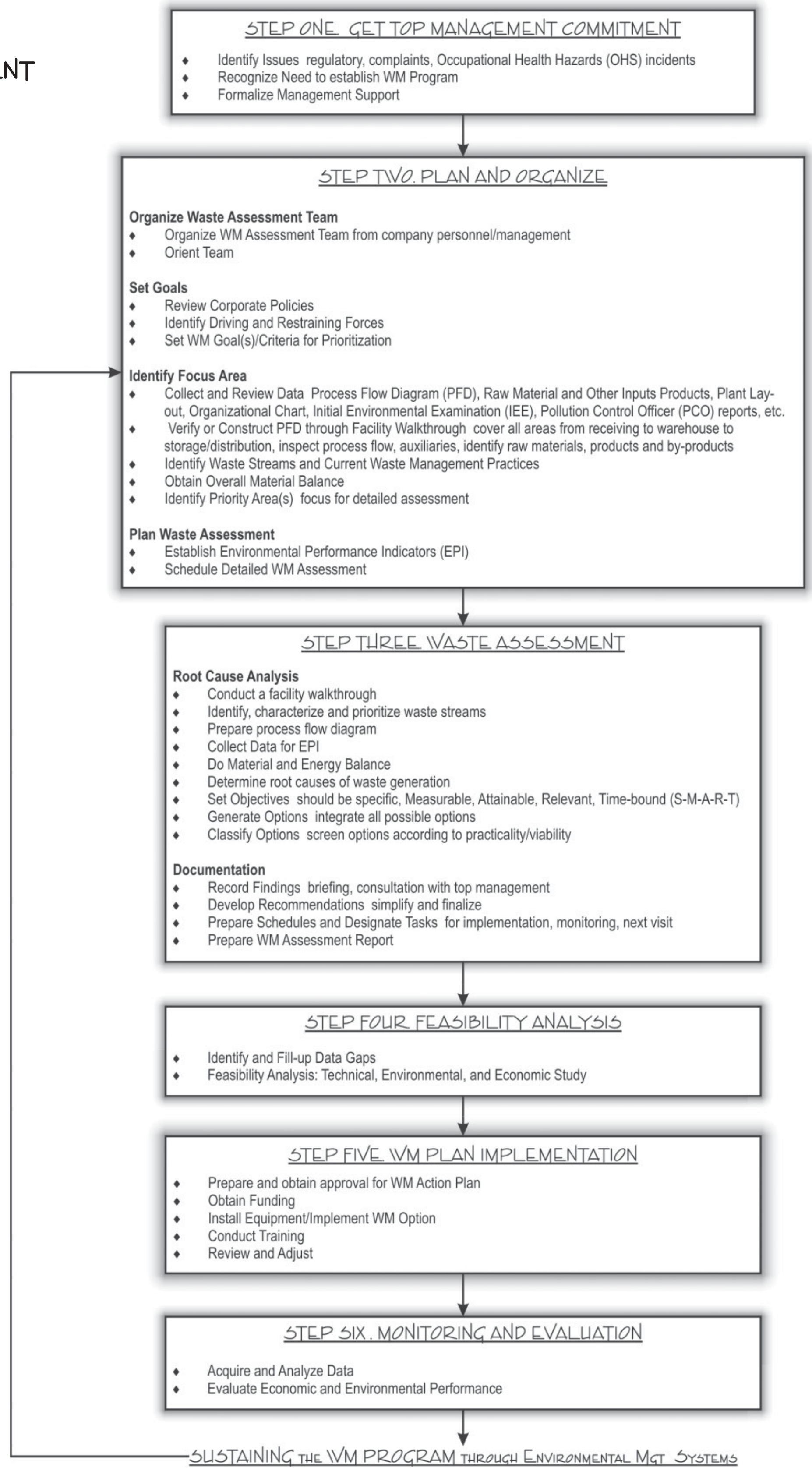
Planning and organizing includes activities such as: (1) forming the waste minimization assessment team, (2) identifying driving and restraining forces, (3) setting goals, (4) gathering and reviewing information / identifying focus areas, and (5) establishing environmental performance indicators.

Forming the Team. Once management is committed, a waste minimization assessment team should be organized, with clear tasks. Information pertinent to the waste minimization program includes production, quality control, financial, waste management, and maintenance data. As such, the team should be composed of individuals from many disciplines and departments.

Identifying Driving and Restraining Forces. The team should identify driving forces and potential barriers for waste minimization. It should use those forces to move the project forward and determine ways to eliminate or minimize restraining forces.

Setting Goals. Setting goals is very important for measuring progress of the waste minimization program. Goals should be consistent with corporate policy so that it will be more understandable to

Figure 2. Waste Assessment Process



all parties and have a better chance of succeeding. Goals should also be specific and measurable so that they are easier to track. The goals must be periodically reviewed and adjusted to ensure that the program remains active and visible within the company.

Gathering and Reviewing Information / Identifying Focus Areas. The data gathered during the planning process should answer several key questions concerning the facility processes, operations, and waste management activities. The higher the quality of data collected, the better the questions can be answered, the easier to identify focus areas and the more complete the waste assessment.

Establishing Environmental Performance Indicators. Performance indicators can help companies understand how well the WM program is working. The company may start by identifying a few performance indicators that are simple and understandable, objective, measurable and relevant to the company goals. Data collected on performance indicators can be quite helpful during WM monitoring and review. Examples of performance indicators include:

- Wastewater generated per unit of production
- VOC emitted per unit of production
- Hazardous waste generated per year
- Percentage of employees completing environmental training
- Energy use per unit of production
- Percentage of solid waste recycled / reused

STEP THREE. Waste Assessment

Waste assessment begins with a review of facility operations. It generally involves five activities: (1) conducting the facility walkthrough or inspection, (2) identifying, characterizing, and prioritizing waste streams, (3) preparing and/or reviewing process flow diagrams, (4) preparing mass balances and (5) generating waste minimization options.

Conducting a Facility Walkthrough. Proper planning and preparation are essential to conducting a thorough facility walkthrough. The facility walkthrough allows the assessment team to observe facility operations and supplement the previously gathered background data. The preferred approach to organizing the walkthrough is to start at the beginning of each process (raw material) and move to the end (finished product and wastes). The facility walkthrough usually focuses

Guide Questions to Consider During Your Facility Walkthrough

- Does your facility show signs of poor housekeeping (cluttered walkways, unswept floors, uncovered material drums, etc.)?
- Are there noticeable spills, leaking containers, or water dripping or running?
- Is there discoloration or corrosion on walls, work surfaces, ceilings and walls, or pipes? This may indicate system leaks or poorly maintained equipment.
- Do you see smoke, dirt, or fumes to indicate material losses?
- Do you smell strange odors, or experience eye, noise, or throat irritation when you first entered the workplace? These symptoms might indicate system leaks, etc.
- Are there open containers, stacked drums, shelvings too small to properly handle inventory, or other indicators of poor storage procedures?
- Are all containers labeled as to their contents and hazards?
- Do you notice waste being generated from processes in your facility (dripping water or steam, evaporation, drag-out, etc.)?
- Do you notice any scrap or out-of-specifications parts lying around?
- Check your inventory. Is there any outdated stock, or materials that are no longer used still in storage?
- Do employees have any comments about the sources of waste in the facility?
- Is there a history of spills, leaks, accidents or fires in your facility? Which processes were involved?

on five areas: (1) receiving and shipping, (2) raw materials and final product storage, (3) production, (4) support services, and (5) waste treatment and storage.

Identifying, Characterizing, and Prioritizing Waste Streams. The successful completion of a waste assessment requires a synthesis of written background information and on-site visual observations. On-site inspections are necessary to verify that the actual day-to-day operations parallel those described in the operating instructions of equipment and process descriptions provided by the facility. Typical examples of waste streams that should be considered during the waste minimization assessment are chemical hazardous wastes, volatile organic compounds (VOC), air emissions, particulate air emissions, wastewater, and solid wastes.

Preparing and/or Reviewing Process Flow Diagram. Process flow diagrams are block diagrams that illustrate the movement (flow) of all materials through the production process. These materials include raw materials, process water, rinse water, final product, and waste. Process flow diagrams help the assessment team (1) locate waste sources, (2) focus on waste generation areas, (3) identify “hidden” waste streams, (4) prioritize waste streams, and (5) prepare the team for and anticipate what operations will be seen during the facility walkthrough.

Annex 1 presents the process flow diagrams for various industry processes.

Preparing Mass Balance. Mass balance are used to understand the system or process and to examine plant capacity, raw material use, waste generation, and recycling efficiency. Mass balance serves as a starting point for identifying and implementing waste minimization efforts. This can be defined by a simple equation:

Mass in = Mass out + Mass accumulated, or
Raw Material = Product + Waste

Determining Root Causes and Generating Waste Minimization Options. The objective of this activity is to take a closer look at where the waste is generated and to identify possible ways to minimize waste in the assessed area. The team should review both general waste minimization opportunities and industry or process-specific minimization techniques.

Documentation. The team now records its findings, develops recommendations and prepares a report for top management.

STEP FOUR. Conducting Feasibility Analysis

A feasibility analysis evaluates waste minimization opportunities identified during the waste minimization assessment. It helps identify the options most likely to reduce the amount of waste generated by a facility. Feasibility analysis is composed of preliminary, technical, environmental and financial screenings.

Preliminary screening is the first step of a feasibility analysis. This step is used to eliminate unworkable options and identify options that are promising. Preliminary screening can also identify low cost and no cost options for immediate implementation. It is used to identify those options worthy of more time-consuming, technical, and financial feasibility screening. One important component of preliminary screening is to set evaluation criteria.

Technical screening may require inputs from process line personnel, equipment vendors, and quality control personnel. Technical screening addresses what equipment and knowledge is needed, training requirements, and whether technical equipment is readily available or must be designed. Options that are technically feasible are passed on to financial screening. Technical equipment requirements, and projected costs provided by vendors are also passed on as inputs to financial screening.

Examples of Possible Technical Screening Criteria

- What equipment and technical knowledge are needed?
- Are new equipment, materials, and procedures compatible with the existing procedures, work flow and production rates?
- Is special expertise required to operate the new system?
- Does the system create other environmental concerns?
- What are the training requirements?
- Is the system safe for workers?
- Will there be compliance to regulatory standards?
- For how long will production be interrupted?

Environmental Screening considers the environmental impacts of each option. This could include reduction in water or air pollution or reduction of hazardous waste generation.

Financial screening considers estimates of the costs and projected savings associated with each option. The level of financial screening should be compatible with the scope of the project and the data available. As a rule of thumb, the assessment team should use the same level of detail that is used to evaluate other projects at the same facility. However, the team should also attempt to estimate costs for items that general financial analysis may overlook.

STEP FIVE. Waste Minimization Planning and Implementation

After identifying available waste minimization opportunities and screening of the available options, the ultimate stage of the waste minimization assessment process is the implementation. This stage involves:

- Preparation of WM action plan
- Getting the approval of the plan
- Necessary steps to implement a waste minimization option
- Forming a waste minimization project evaluation team
- Selecting waste minimization options for implementation
- Obtaining funding
- Implementing options
- Installing equipment
- Conducting training
- Reviewing / adjusting as needed

To demonstrate the success of a waste minimization project or to determine if the project should continue, methods must be developed for measuring the extent to which waste minimization has been achieved.

Data should be collated before a project is implemented, after a project is implemented, and periodically during the project's life.

STEP SIX. Long-Term Monitoring and Evaluation

The success of waste minimization depends on long-term monitoring. The information listed below should be collected before and after all waste minimization efforts.

- ❑ Waste quantity and composition
- ❑ Waste management costs
- ❑ Production capacity and product quality
- ❑ Production costs (including raw materials)
- ❑ Utilities and maintenance costs
- ❑ Environmental, health, and safety costs

Calculation of waste minimization costs and savings should serve as a springboard for further action, including the possibility of the company to pursue the establishment of an Environmental Management System (EMS). Initial technical and economic expectations should be compared with actual performance. The facility should learn from its experience and use this knowledge to further improve its waste minimization program.

Worksheets for companies to use for gathering facility baseline information. Developing a Waste Minimization Action Plan, and Monitor Waste Minimization Program Implementation are provided in Annexes 2, 3 and 4, respectively.

3.0 Waste Minimization and productivity improvement Techniques

Once a company has a Waste Minimization Plan it must be clear how it will achieve it. The WM Team can use several techniques that will reduce waste and also increase productivity, because this is the strongest selling point for business entities to undertake action. If companies can manufacture the same volume of products with fewer resources such as raw materials, energy, and water, they can reduce production costs and consequently increase their profits.   Saving energy, reusing and recycling materials, selling by- products, and reducing waste generated at source are some of the ways to improve resource productivity, and at the same time reduce environmental impact of the corporate activities

This section describes various waste minimization and productivity improvement techniques that can be applied in a manufacturing setting.   In addition, industry specific WM opportunities are also presented for focus industry sectors: Food (Fruit) Processing, Foundry/ Metalcasting Pulp and Paper Milling, and Chemical Processing are also presented.

3.1 WM techniques Overview

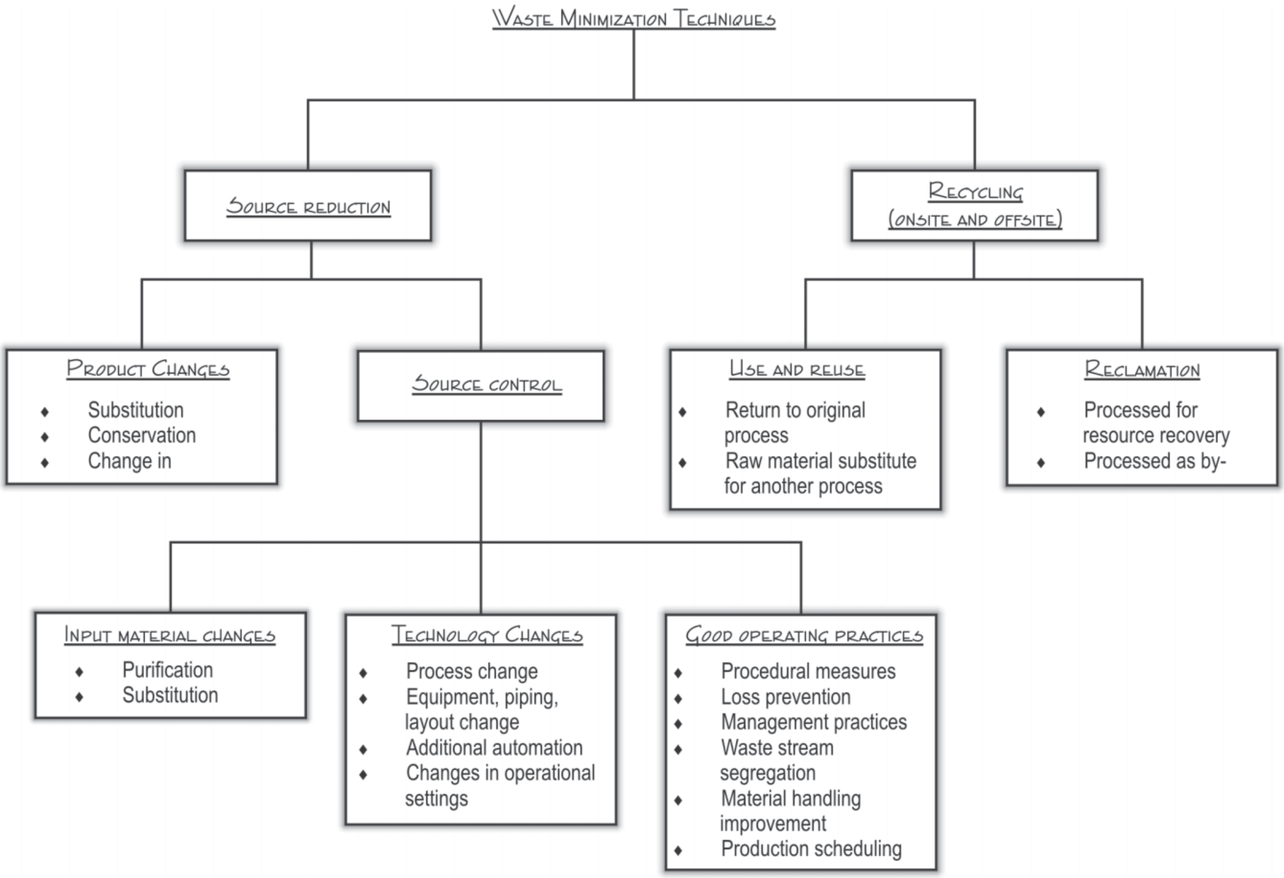
Identifying appropriate and effective WM options is the critical step in making WM programs a success. The process of identifying and selecting WM options should follow a hierarchy, in which source reduction options are explored first, before recycling options. This hierarchy stems from the environmental desirability of source reduction as the preferred choice in minimizing wastes. Source reduction techniques are characterized as good operating practices, technology changes, material changes or product changes. Recycling techniques are use/reuse and resource recovery techniques. Figure 3 presents the WM Techniques Diagram.

3.1.1 Source Reduction Techniques

Source reduction can be done by modifying production process, substituting or improving the purity of the feedstock, implementing improved housekeeping and management practices, and increasing the efficiency of the machinery. Source reduction includes actions that cause a net reduction in the volume of wastes generated or that minimize a waste's toxicity or pollution load. Source reduction does **not** include:

Actions taken after hazardous waste is generated, for example: incineration, thermal, chemical or biological decomposition, stabilization, solidification, or encapsulation

Figure 3.
Waste Minimization Tecniques



Actions that merely concentrate the constituents of hazardous waste to reduce its volume (although this may be part of a recycling alternative)

Actions that dilute hazardous waste after it is generated to reduce its hazardous characteristics

Actions that shift hazardous waste from one environmental medium to another. For example, using pollution control devices to control air and water pollution often results in a concentrated waste. These wastes (for example, filter gases or spent air filters) are often disposed of in land disposal sites. In this case, pollution has not been prevented. It has merely been transformed from one medium (air or water) to another (land).

There are four source reduction techniques:

Operating practice changes. These are changes in how employees perform their duties and responsibilities. Changes in operating practices can achieve significant results with little or no capital requirements. They are extremely important especially for small and medium sized facilities, which may not have the capital for large-scale process changes. Significant amount of waste may be generated at the facility through spills, improper storage practices, scheduling problems, lack of emergency procedures and preventive maintenance, and poorly calibrated instrumentation. By changing operational procedures, significant source reduction may be achieved.

Input material changes. These are also called material substitution. They reduce or eliminate hazardous or pollutive materials entering the production processes. An example is the use of water-based ink instead of solvent-based ink.

Technology changes. These are modifications in equipment and processes to reduce waste generation. They include changes in production processes, equipment, layout, or piping, automation, and operating conditions.

Product changes. These are performed by the manufacturer with the intent of reducing waste during production and/or during use of the product. Product changes include product redesign or changes in product composition, product substitution and product conservation. Examples are the use of concrete utility poles rather than chemically treated ones, or the use of a cloth lunch bag or shopping bag or the local “bayong” instead of paper or plastic bag.

3.1.2 Recycling, Reuse and Reclamation

Recycling and reuse involves returning process “waste” either to the generating process or to another process as an input material. This can be done on-site or off-site. On-site recycling is the reuse of waste materials at the site of generation. Off-site recycling involves transporting the waste to a commercial recycler who processes the wastes and returns the material to the original generator or sells it to another industrial customer.

Another type of recycling is called reclamation. Reclamation is the recovery of valuable materials from wastes. Reclamation processes also generate wastes, which will require proper treatment and disposal.

3.2 Productivity Improvement

Examples of Typical Abnormalities in Operations that May Not be Easily Identified by the Workers

- The motor vibration sounds larger than the one at the yesterday’s daily inspection.
- When the button for size adjustment is changed by one scale, the size of the product becomes too big.
- Raw materials are usually kept at – 1 degree Celsius, but a worker feels that they are warmer than usual.
- Exhaust gas from the outlet seems yellowish, and there are powdery things scattered on the floor.
- When products are piled up, they seem to have less adhesive than usual.
- The display plot of the automatic measuring machine for product size stays at the center and does not move.

- One worker can finish the same work one hour earlier than others, and her/his work looks great.
- One machine produces losses twice larger than other machines for the same volume of products

Resource productivity improvement and waste minimization (environmental performance improvement) are not independent each other but go hand in hand. Companies can achieve these two objectives at the same time. Giving up good environmental performance for the sake of productivity improvement does not make sense. It is the owners or top executives' responsibility to make a decision on production facility construction, resource allocation, education and training of their staffs in order to improve resource productivity and environmental performance.

Resource productivity can be improved for example through the following reductions:

- Reducing industrial waste by improving yield rate
- Reducing wastes generated from processing raw materials such as disqualified products, trashes and dusts as well as waste generated from maintenances of production facilities such as waste oils, wastewater, emissions, which is an important subject for cost reduction.
- Reducing defective products and elimination of adjustment works.
- Improving capacity to produce final products by single operation at a production line, which contributes to elimination of losses of production time and adjustment works
- Reducing in other management losses
- Reducing deteriorated products kept in storage for a long time, handling losses by damaged products, and treatment costs.

Education and training of those who are directly in charge of production management and production activities are the most crucial factors for successful resource productivity improvement. Workers' "sensitivity" defines the level of productivity and environmental performance. If workers are not able to recognize abnormalities in the operations (defect) as critical problems, then these problems can not be corrected. One important consideration in productivity improvement is the workers consciousnesses to identify abnormal conditions and then take necessary actions to correct them:

There are many available tools to enhance workers' sensitivity. Annex 5 presents an example of an effective tool to increase workers' sensitivity.

3.3 Various Tools for Identifying Problems and Solutions for WM and Productivity Improvement

The very first step in WM and Productivity Improvement is recognizing the NEED to identify and recognize existing problems in the operations and to anticipate potential problems. There are many available tools for this process. The seven quality control (QC) tools can be adopted to identify and recognize the need to implement WM and productivity improvement.