“TO INVESTIGATE THE IMPACT OF AN INDUSTRY (DEALING WITH POWDER COATING) ON THE ENVIRONMENT”

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RESEARCH AND PLANNING

Introduction

There is so much pollution in the air now that if it weren’t for our lungs, there’d be no place to put it all.

- Robert Orben

Pollution – The introduction, by humans into the environment, of substances or energy liable to cause hazard to human health, harm to living resources and ecological systems, damage to structure or amenity, or interference with legitimate uses of the environment.

Different kinds of pollutions created from the action of human activities disrupt the normalcy in the environment.

The World Bank projected that on an average 1.8 million people would die prematurely each year between 2001 and 2020 due to air pollution. The world is facing a global environmental crisis. Our unsustainable way of consuming natural resources at a greater rate than that at which nature can regenerate them and the rapidity with which we are polluting the planet, can only lead to a catastrophe, World Health Organization consistently rates New Delhi and Kolkata as being amongst the most polluted mega cities of the world.

Numerous pollutants are liberated by different sources, one such is industry. Industrial pollution dates back to antiquity, but widespread industrial pollution is never limited to industrial nations. Samples of ice cores from Antarctica and Arctic also show high levels of industrial pollution.

India is Asia’s most developing country. 60% of the people are employed in the primary sector. 30% are employed in the Secondary and Tertiary sector. This makes India a developing country. Some big cities in India are developing at a very high rate.

Objective
With the study on India’s carbon footprint, the hypothesis I have considered, is to investigate the impacts of a Powder Coating Industry situated in Bangalore, on the environment. The purpose of the study is to find out the process involved in powder coating, its environmental effects; and the measures taken by the industry to control pollution; the sustainable measures that can be taken by the industry to control Carbon emissions.

Methodology
Investigative avenues used for the study:

1. Survey of the Industry- it includes a site visit of the industry with a study of the location, surroundings and the working atmosphere and environment.

2. Interview- I personally interviewed the manager of the industry, who was also the owner.

3. Social survey- I did this to basically understand the views of the local people about the industry.

4. Secondary Sources of data- I gathered more information from media reports, websites and journals to support my project.

5. Investigating sustainable measures that the industry can follow for controlling the Carbon emission

6. EIA report- This is also included to find out the Industry’s effect on the environment.

The above said plan may be effective in testing the hypothesis.

DATA COLLECTION AND PRESENTATION

My project work focuses on an industry that deals with powder coating. I paid a visit to the industry on the 10th of December, 2009, Wednesday. There I spoke to the Senior Manager and took his permission.

Powder Coating

Powder coating is a type of dry coating, which is applied as a free flowing powder. The main difference between a conventional liquid paint and a powder coating is that the powder coating does not require a solvent to keep the binder and filler parts in liquid suspension form. The coating is typically applied electro statically and is then cured under heat to allow it flow and form a ‘skin’. The powder may be a thermo plastic or thermo set polymer. It is usually used to create a hard finish that is tougher than conventional paint. Powder coating is mainly used of coating of metals, such as ‘white-ware’, aluminum extrusions such as MDF (medium-density fiber board), to be powder coated using different methods.
The area covered by this industry is approximately 3000 sq. ft. This industry powder coats all kinds of metals such as iron, aluminum, etc. It gets industrial orders to powder coat racks, plates and other components.

**Process Of Powder Coating**

It involves three major steps:

1. **Part Preparation and Pre-Treatment**
2. **Powder Application**
3. **Curing**

**Part Preparation Process and Equipment**

Removal of oil, soil, lubrication greases, metal oxides, welding scales etc., is essential prior to the powder coating process. It can be done by a variety of chemical and mechanical methods. The selection of the methods depends upon the size and material of the part to be powder coated, the type of soil to be removed, and the performance requirement of the finished product.

**Chemical pre-treatments**

It involves the use of phosphates or chromates in submersion of spray application. These often occur in multiple stages and consist of de-greasing, etching, de-smutting, and various rinses and the final phosphating or chromating of the substrate. The pre-treatment process both cleans and improves bonding of the powder to the metal.

The industry also uses another method of preparing the surface prior to coating, known as abrasive blasting or sand-blasting and shot blasting. Blast media and blasting abrasives are used to provide surface texturing and
preparation, etching, finishing and de-greasing for products made of wood, plastic or glass. The most important properties to consider are chemical composition and density, particle shape and size, and impact resistance.

Silicon carbide grit blast media is brittle, sharp, and suitable for grinding metals and low-tensile strength, non-metallic materials. Plastic media blast equipment uses plastic abrasives that are sensitive to substrates such as aluminum, but still suitable for de-coating and surface-coating. Sand blast media uses high-purity crystals that have low metal content. Glass bead blast media contains glass beads of various sizes.

Cast steel shot or steel grit is used to clean and prepare the surface before coating. Shot blasting recycles the media and is environmentally friendly. This method of preparation is highly efficient on steel parts such as I-beams, angles, pipes, tubes and large fabricated pieces.

**Application Processes**

The most common way of applying the powder coating to metal objects is to spray the powder using an electrostatic gun, or Corona gun. The gun imparts a positive electric charge on the powder, which is then sprayed towards the object, which is grounded. The object is then heated, and the powder melts into a uniform film, and is then cooled to form a hard coating. It is also common to heat the metal first and spray the powder onto the hot substrate. Preheating can help to achieve a more uniform finish but can also create other problems, such as runs caused by excess powder.

**The different photos showing the Application process and the Booth**

This part of the process is done in an enclosed compartment called as a BOOTH. A worker enters the booth, closes it from all sides and then sprays the powder on the product which is placed within the booth itself. The booths vary in sizes according to the size and requirement of the industry. This industry has tow booths, one big and the other a smaller one.
The gun used by them to spray the powder

Powder can also be applied by using specifically adapted electrostatic discs.

**Electrostatic magnetic Brush (EMB) Coating**; an innovative coating method for flat materials that applies powder coating with roller technique, enabling relative high speeds and a very accurate layer thickness between 5 and 100 micrometre. The base for this process is conventional copier technology. Currently in use in some high-tech coating applications and very promising for commercial powder coating on flat substrates (steel, Aluminum, MDF, paper, board) as well in sheet to sheet and/or roll to roll processes. This process can potentially be integrated in any existing coating line.

**Curing**

When a thermoset powder is exposed to elevated temperature, it begins to melt, flows out, and then chemically reacts to form a higher molecular weight polymer in a network-like structure. This cure process, called crosslinking, requires a certain degree of temperature for a certain length of time in order to reach full cure and establish the full film properties for which the material was designed. Normally the powders cure at 200°C (390°F) in 10 minutes. The curing schedule could vary according to the manufacturer’s specifications.

The different photographs showing the Convection Cure Oven
The application of energy to the product to be cured can be accomplished by convection cure ovens or infrared cure ovens. This industry uses the older convection cure ovens.

Removing Powder Coating

Methylene Chloride is generally effective at removing powder coating however most other organic solvents (Acetone, thinners, etc.) are completely ineffective. Most recently the highly dangerous Methylene Chloride has been replaced by Benzyl alcohol with great success by the industry.

Product Packaging

Once the product has gone through the whole powder coating process, it then has to be sent to the customers. The product is not sent as it is, it has to be packed. For packaging, the industry uses plastic films and thin layers of Styrofoam to avoid any scratches or damages on the surface of the product. The packing material looks like that shown in the photograph below. After the industry wraps the product with plastic film and Styrofoam, it is then delivered to the customers.

The packaging of the product

[Images of packaging materials]

ANALYSIS

With the collected data from the industry in the form of observing the powder coating process, interview, the following analysis is done about the industry.

It is a known fact that unlike solvent based wet paint, powder coating is an environmentally friendly process. Since it does not use solvents in any ways, Volatile Organic Compound emissions are eliminated.

This industry was certified by the Pollution Control Board after 2 years of its installation. But regular monitoring was not done by the authorities.

In the ETP (Effluent Treatment Plant), the wastes in the form of sludge are collected in the Collection Tank and they then go through a filter. The rest of the waste is collected in a sludge drying bed. The dried sludge kept in bags and is then sent to the pollution control board for landfills. The water used in this process is used for watering the plants in the compound.
Here again, as mentioned earlier, though the company had implemented measures like the ETP when it was first established 12 years back, they haven’t been able to maintain the quality standards. The parts have become old and hence do not function properly.

The poor state of the ETP can be seen blow;

![ETP Image]

The ETP, which as you can see is in a bad state

With the above said analysis, it is clear that to a certain extent the industry is environmentally friendly. But, the industry has no resource efficiency initiatives which can lead to CO2 emissions.

During my survey, I found that the convection ovens used to cure the products were not switched off when not needed. This industry does little to save energy-as its high oven temperatures can be reduced to get similar quality. This industry has also not implemented the 3 R principle of Reuse, Recycle and Return. The cardboard boxes and other packing materials can be reused after taking them back from the customers. Waste cardboard and paper could have been recycled by themselves-instead they waste it by buying new ones every time, the industry can return the containers to the powder manufacturers or suppliers after the powder is used. To reduce energy consumption, the industry is not implementing any efficient technology. More amount of electricity is consumed which can be minimized by using solar energy or both alternative sources of energy (50%) and fossil fuels (50%). The used water can be recycled/treated and reused again to bring down the level of water consumption. Before the powder is coated, I found that the powders are not stored properly. Furthermore, during the process of adding color to the powder and filling it into the gun, a lot of powder is wasted while handling. This could be avoided by a more careful handling of the powder and coloring compounds. Even in the spray booth some amount of powder is wasted. This can be done by using a more technologically advanced booth which has filters at the bottom. It collects the waste powder, filters it and the re-uses it. This can be seen in the photograph below:

I collected water samples used for watering the plants. When I checked the Ph of the water it was more than 7.5. So the water was alkaline. In the long run it is not good for the quality of the soil. From this it is understood that the water is not treated efficiently.

Social Survey

Since this industry is located in an industrial area, there are no residential places near it, and thus a social survey could not be conducted.
An EIA report has been prepared for the industry.

EIA - Environmental Impact Assessment

Description of site – This particular industry that I visited is located in an industrial area. It has many other industries located adjacent to it. There was absolutely no residential activity taking place in or around this area.

Description of Positive Environmental Impacts – They are environmentally efficient to some extent. They are certified by the Pollution Control Board and have installed an ETP.

Description of Negative Environmental Impacts – Though they have implemented measures, they haven’t been able to maintain them. The ETP is in a bad state and there is a sense of disorder in the working of the staff which leads to environmental issues.

Identification of Alternative - This particular industry could have used solar energy by installing solar panels, but instead it is using power driven from fossil fuels like coal.

Waste minimization and Recycling Plans - Though waste is minimal in the case of this industry, apart from the fact that it wastes powder through careless use during the process, the recycling plant implemented could have been more efficient thus reducing the small percentage of environmental pollution.

Mitigation Plans – Though this industry, when it was established 12 years back, had state-of-the-art mitigation plans like fire extinguisher for emergencies, it hasn’t been able to maintain the same level and these plans have deteriorated without renewal.

CONCLUSION

Though this industry was more or less eco-friendly, it was only to some extent. There are further some policies/ways to work that this company can implement to achieve the status of a 100% environmentally friendly company.

1. Reduction of carbon Foot Print – as we are aware that powder coating occupies quite a large market segment in the painting market hence, if it reduces its carbon Foot Print (shown in graph 1.0)

11. Higher profits for the Company - we know that there is an increased awareness amongst the people and they are becoming more aware particular about buying products from ‘green’ companies. If this company ‘goes green’, it will have a competitive advantage over the other companies.
But, sustainable development comes at a price. The company, according to me, should opt for a step-by-step approach to sustainable development as explained below:

1. Reduce- reduce the use of energy and resources in various forms. It should bring down its consumption of electricity and water. This also includes reductions of wastes like a more careful handling of chemicals and powders.

2. Re-use- it can re-use up to 85-90% of the water for its own use in processes like pre-rinse and pre-treatment process. This will further help reduce the overhead costs of the company. (moreover, water re-cycling is a very cost-effective and simple process)

3. Return- the plastic containers which have the powders and others used for storage can be returned to the suppliers or retained for further usage. This eliminates the requirement of new containers every time, further reducing the overhead costs of the company.

If the company follows this step wise reductions in its costs, it can push up the margin and hence earn a greater profit.
The graphs showing reduced costs and increased profits

D1 - demand curve showing present quantity demanded
S1 - supply curve showing present quantity supplied
P1 - equilibrium price set by the market forces
E1 - equilibrium point

If the company continues its 'non-green' ways then D1 will shift to D2 and due to this, price will also fall to P2.

If the company goes 'green' then demand for its products will increase D3, thus creating D3. This will in turn lead to a raised price P3 and hence PROFIT MARGIN increases.
After my site visit, I realized that this company has already implemented some eco-friendly and energy-efficient steps like;

- Effluent Treatment Plant to treat the water which is then let out into the soil and used to water plants and trees around the company.
- Waste disposal system is also quite efficient.
- The industry is also maintained well with fire extinguishers and first aid kits in case of emergencies.

According to me, the company could have also done the following:

- Firstly, it should reduce the usage of water. It can make significant reduction in waste discharge by eliminating unneeded pre-rinse steps or by using counter flowing rinse baths and then re-claiming the used rinsed water.
- Water can be conserved by recycling and reusing for the process of powder coating.
- Use more efficient and advanced technology like plasma coating.
- Use state-of-the-art Booths which have provisions to reuse the wasted powder.
- This company is twelve years old. Then, it was a modern and efficient unit but now it has deteriorated. They have not paid attention and most of the equipment is now outdated.
- The fire extinguishers and other safety mechanisms should also be renewed periodically.

GOVERNMENT POLICIES

The steps that the Government should take are:

- Provide subsidies to companies that are eco-friendly and more environmentally efficient so as to encourage them.
- The government should also try to find some new technology and also fund Research and Development to reduce the negative impact on pollution.