The Pennsylvania State University
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ArcelorMittal
Waste Stream Reuse and Recycling

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The Illuminati
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## SECTION 4. SUMMARY

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ArcelorMittal, a major steel production company, is looking for a way to reduce the amount of waste in the production process. With the objective to reduce their waste stream by reusing or recycling one of their major waste product, the design team chose the 50-gallon plastic totes containing water treatment chemicals. The proposed solution is to reuse these totes to create commercial floating docks. The solution is explained and is accompanied by an extensive cost and feasibility evaluation. The plan for production and sales is also considered, making the conceptualized idea ready to be transformed into reality.
SECTION 2
INTRODUCTION

2.1 PROJECT OBJECTIVES.
The goal is to reduce ArcelorMittal’s waste stream at one of its facilities by designing an opportunity to reuse and/or recycle one or more of the largest sources of refuse: pallets from incoming material delivery, empty drums or totes received from delivery of fluids, and waste refractory brick.

2.2 PROJECT BACKGROUND.
Steel is one of the most common materials used by modern societies, yet it is also a finite resource. Steel and many other finite resources follow a process known as “Cradle-to-grave,” in which the resources eventually end up in a landfill. However, what if there was a way to transform this “Cradle-to-grave” process in a cyclical “Cradle-to-cradle” process. Not only will recycling these materials reduce the amount of waste, but it can also reduce production costs.

The use of recycled steel has been a part of the steel industry since its beginnings, but some of the byproducts of production are not. Many steel companies are able to sell the slag produced in the process of making liquid steel for roadbed filler, and some also sell the iron oxide mill scale byproduct. ArcelorMittal espouses company values of Sustainability, Quality, and Leadership. In support of the value of sustainability, they look to reduce their overall waste stream to improve the sustainability of our processes. Also, reducing the amount of waste will, in turn, reduce disposal costs, and improving profitability also helps the long-term sustainability of a business unit.

2.3 SPONSOR BACKGROUND.
Our partner in this project is ArcelorMittal USA, the largest steel producer in North America and the largest integrated steel producer in the United States. ArcelorMittal is the leader in all major global steel markets, including automotive, construction, household appliances, and packaging. It is the world’s largest and most global steel company by both revenue and production, with over 285,000 employees in 60 countries.

ArcelorMittal operates in three divisions in the USA: Flat Carbon, Long Carbon, and Tubular. The Steelton, PA, plant is in the Long Carbon division. Similar to the other Long Carbon plants, the Steelton plant manufactures steel from recycled scrap metals. This plant has a liquid steel-making capacity of about 1.1 million net tons of steel per year. Product lines include cast and rolled blooms for the forging and re-rolling industries; rails for railroad, transit, and crane application; rolled billets, squares, and flats; construction equipment sections; and large diameter specialty ingots.
2.4 PROJECT CATEGORIES.
ArcelorMittal Steelton purchases refractory brick of several types and chemical compositions for varied applications throughout the mill. ArcelorMittal Steelton also purchases many other items for which the manufacturer does not accept return of packaging. While many drums of oils or lubricants may be refilled with waste oil for proper disposal, some other commodities come in containers that are not returned. For instance, water treatment chemicals (for preventing algae growth in heat treating equipment) come in 50-gallon plastic totes. Similarly, antifreeze, which is mixed with water for wintertime ultrasonic coupling, comes in 50-gallon metal drums. Finally, many other purchases, such as motors or rollers, come on wooden pallets. ArcelorMittal does not wish to receive this material completely without pallets, as the pallets facilitate the movement of material by forklift.

2.5 PROBLEM STATEMENT.
The ArcelorMittal waste item that our design team chose was the 50-gallon plastic totes containing water treatment chemicals. Plastic is one of the most littered items, with a recycling rate of only 9%. 32 million tons of plastic waste were generated in 2012, and the United States generated about 14 million tons of plastics as containers and packaging in that same year. Based upon these statistics listed above, it is therefore imperative that something must be done in order to avoid creating an even more immense amount of waste. Although this must be a global effort, one company, such as ArcelorMittal, can make a difference.
SECTION 3 METHODOLOGY

3.1 SUSTAINABILITY.
Sustainability is the ability of something to support and uphold itself. Environmentally speaking, sustainability is how an object will behave in the future, particularly that it will not be harmful to the environment. Sustainability is imperative when analyzing it from a global perspective, because all of our actions now will greatly affect the future of earth. Sustainability is an important aspect of each community, not only environmentally but also economically. However, moving to a more sustainable lifestyle requires governmental intervention, scientific advancements, and an adjustment to each individual’s lifestyle.

3.2 RATIONALE FOR SELECTION.
Plastic is the one of the most wasted products in the U.S., and takes longer than any other material to naturally decompose (ranging from 450 to 1000 years). Additionally, plastic is also the key component in the design process that was constructed. ArcelorMittal receives water treatment chemicals and anti-freeze in 50-gallon totes. Once the chemicals are removed from the barrels, they are now left with hundreds of empty plastic drums that must be taken care of. Rather than adding to the extensive amount of plastic waste, these barrels can be utilized in a much more environmentally friendly and economic process.

3.3 DESIGN CONCEPT.
The initial idea consists of re-utilizing the plastic drums as the base for economic and recyclable water docks of various sizes and purposes. The design basically consists of grouping a set of plastic barrels, filled with some lightweight material, such as foam, but even that is just an option, since foam filling is not required for barrel-made docks, and then placing a thin platform on top, either made out of wood, plastic or metal. The standard model will consist of 4 barrels in width and 4 in length. The idea is to create a floating structure that can be easily maintained and is more affordable than the standard wooden piers or standard rectangular dock-floats.

3.4 REGULATORY ISSUES.
Floating large docks made of recycled barrels could have negative environmental effects on the body of water they are placed in. For example, there is considerable evidence that docks shade sea grass beds and other plants, alter patterns of water flow, introduce chemicals into the marine environment, and impact public access and navigation along the waterway. One of the most common chemicals involved in this process are oil based preservatives applied to the surfaces of wood, but there are many laws which have banned such use in aquatic settings. However, one of the biggest environmental concerns that may be faced in the process of implementing docks using plastic barrels will involve the materials that are in the barrels prior to being placed in the water. In order for these large plastic drums to be reused, they must be sent to facilities for a
“triple rinse” or pressure rinse process, which must follow the guidelines provide by the Code of Federal Relations Part 165.

3.5 STAKEHOLDERS.
By recycling the plastic drums, the government is able to reduce time and effort in the management of Landfills. Also the new jobs created through the prices will encourage economic development and therefore increase tax revenues for the government. The community will also benefit from recycling, as there will be a reduced amount of waste in the local community. In the long term this means reduced carbon emissions and toxic fumes from the burning and decomposition of plastics. This will create a better living environment for all lives in the local community. At the same time, the implementation of the drum recycling process, which includes the cleaning of the drums, helps create job opportunities for the locals.

The owners benefits from this solution since the company is able to gain a better name and standing with their customers, with their new contributions to the community. At the same time it is also economically beneficial as companies have to pay a levy for their contribution to the landfills. For example in the state of New Jersey, according to the Environmental Protection Agency, the service tax per ton of solid waste is $1.05 in addition to another $1.05 for recycling the waste. At the same time the revenue earned by the company from the resale of the plastic drums will add to the company’s total profit. With the reduced cost in the manufacturing process of steel, it is likely customers will be able to benefit from better negotiated prices for products and the purchase of "greener" products. Additionally with the saved costs through reduced Levy's, the company may be able to allocate more money towards the purchase of raw material benefiting the suppliers.

3.6 ASSESSMENT OF AMOUNT OF WASTE DIVERTED FROM LANDFILLS.
With each barrel having a volume of 7.35 cubic feet, one of our floating piers would have a volume of 117.6 cubic feet. To put this into perspective, just six of our docks could fill a garbage truck with waste. This would weigh over 350 pounds and take 450 to 1000 years to biodegrade. With 240 docks produced per year, over 28,000 cubic feet of plastic waste can be diverted from landfills every year.

3.7 ECONOMIC ASSESSMENT.
Every dock has a cost of $191.81 for decking materials, and $208.18 for labor. This estimate does not include the $586.67 saved by using recycled barrels. The Illuminati can produce 240 docks per year, resulting in $1,267,207.20 worth of barrels saved and a profit of $144,000.

3.8 SYSTEM DIAGRAM/MODEL.
Figures 1.1 and 1.1 show the initial model for the recycled barrel docks, which consists of three barrels width by three barrels length attached to each other under a wood platform. The simplicity of the model implies that it can be modified to satisfy whatever function, making them bigger or smaller. The three by three was designed in order to provide a stable and easy to build platform that can perform multiple tasks, serving as a recreational platform or as a small boat dock.
Figure 1.1 Isometric view of SolidWorks model

Figure 1.2 Side view of SolidWorks model
3.9 ENVIRONMENT IMPACTS.

Since the barrels will be thoroughly cleaned before assembly, the environmental impact of using the recycled barrels as the floating base for the dock will be minimal, as the plastic barrels can endure corrosion very well, as well as not being particularly affected by changing temperatures. The barrels also do not require any foam filling in order to float effectively, like the floating platforms that can be found in the market, therefore ensuring that if a barrel is damaged, no harmful materials are leaked into the water, which could potentially impact the quality of the water, and therefore the wildlife present as well as the use of the water.

By re-utilizing a large amount of barrels and marketing around the country the company would ensure that the barrels do not take end up forming part of the larger problem of waste accumulation as well as ocean pollution. The barrels would be taken out of a vicious and anti-natural cycle which harms the ecosystems of the communities the docks would be sold to. The barrels are easy to work with and as a result the company could reduce its pollution footprint by a sizable margin, placing it in a position of leadership in terms of recycling and pollution containment, setting the example for many other companies.
3.10 PRODUCT DEVELOPMENT AND MARKETING.
The barrels will be triple-rinsed (see section 34) and the docks produced in a production plant near ArcelorMittal’s factory (source of drums). They will then be tested in an isolated pool to test for chemical spillage and efficiency on the water. From there, the finished product will be shipped to distribution centers near waterfronts to be sold to middle/lower-class families with river/lake-front homes. This audience will be most likely to want low-cost, pre-made docks.
Implementing this concept design for a dock made out of the waste plastic barrels would improve the way in which processes are carried out in ArcelorMittal, making it a reference in the field of industry and a more environmentally friendly company. The company could greatly benefit from re-utilizing its resources, in this case their plastic barrels. They could make a substantial profit out of it if marketed and managed right; however, it is important to say that the design is preliminary, so in order for it to become a more feasible achievement for ArcelorMittal, more designing as well as testing would be required.

The main strength of this design is its simplicity, which makes it easy to build, interact with, and modify. As it is so simple it can be transported in an easy manner, as well easily dismantled and rebuilt, and easy to maintain. The main disadvantage of this design is that the docks would not be made entirely out of recycled material, as wooden docking would have to be bought by the company in order to fabricate the docks, at least for the time being. This problem can be solved over time by partnering with other companies and only selling the empty barrels to be cleaned by a secondary company, which would in turn provide the wooden materials and could market the product. Implementing this design would ensure a more environmentally friendly conscience, and could potentially benefit the neighboring quality of life, as less waste would go into dumpsters and other places where they would take a toll on the quality of the environment rather than becoming an inoffensive part of it.

Despite the absence of discussion for an alternative solution, or application in this report, the plastic barrels could also be utilized in a harbor setting. They could be re-utilized to transport materials after they are cleaned, or also to form softer edges to piers and docks to prevent damages of nearby boats as they dock or remain in place.

It is the firm belief of this design team that the project is not only feasible, but also feasible in the short run, as the logistics of the project are not complicated, and the main points of focus would be having a facility to clean the barrels as well as assembling them to the wooden docking. The marketing of the project can be resolved with small and targeted marketing campaigns that target homes lying close to rivers or lakes, and have an interest in a cheap and easily maintainable dock for recreational or professional purposes. This project could become something much bigger than what it is, for it would represent the ability of a company to improve their impact on the environment while bettering their local communities.
Works Cited


