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Mission Statement, Specifications:

With ArcelorMittal, we had the opportunity to explore the various uses of things we would have never thought as profitable. We were given the objective to reuse at least one of ArcelorMittal’s waste products: wooden pallets, used refractory brick, and plastic drums and totes. We had to reuse them in a way that would be cost effective, sustainable, and with a growing purpose.

We decided to focus on both the refractory bricks and the wooden pallets. Through the design process, we found out that there are companies, Orbit Radiant Heating and Used Refractory, that make good use of these materials. As engineers it is our job to find the best alternative for the wooden pallets and refractory bricks. After brainstorming, we decided to package and ship the brick, using the pallets to these two companies for reuse.

Concept Generation:

ArcelorMittal’s largest sources of waste comes from pallets of incoming material delivery, empty drums or totes received from delivery of fluids, and waste refractory brick from the furnaces. As our team was brainstorming ways to recycle these materials, we decided to focus on either bricks or pallets because we thought they would have the most versatile uses.

ArcelorMittal ships and purchases many products, such as motors or rollers, which come on wooden pallets. These pallets help facilitate the movement of material by forklift. However, ArcelorMittal has not been able to work out an ongoing solution for the removal of used pallets. Other waste lumber is also generated; and often it is offered free to employees.
who wish to burn it at home. Unfortunately, any excess lumber is simply thrown away. To fix
this, our first idea was to turn the recycled pallets into some kind of furniture, but we were
unsure of the condition and quality of the wood. Then, we started to think of using these
pallets for small outdoor furniture or even tree houses. Once again, the quality of the wood
was something we would have to look further into. We also brainstormed about producing
mulch, but further research was required later in the design process.

Our next focus was a way to recycle the refractory brick. ArcelorMittal Steelton
purchases refractory brick of several types and chemical compositions for varied applications
throughout the mill. Among the applications are furnace brick, ladle brick for lining of the
liquid steel ladles, brick for construction of runners for the pouring of ingots, brick for
maintenance of reheating furnaces and facilities, and cast hard refractory for furnace doors
and lintels (ArcelorMittal). One idea we had was to recycle this brick by selling the brick to
companies that would resell it online. We found one company, called Used Refractory, which
does just that. We also thought of rebuilding with the refractory brick, since it is still in good
condition after ArcelorMittal uses it. Some ideas we formulated were brick ovens, fireplaces,
heated driveways and walkways, ceramic ovens, etc. Through brief external research, we
discovered Orbit Radiant Heating; a company that allows large companies to become
distributors for their heating products.

Concept Selection:

Our brainstorming session was quite productive and, therefore, we had several
ideas to sift through. We first started with a brief concept screening between all of our
ideas (see in Appendix). This helped us to focus on the best possibilities. We found that
the wooden pallets from ArcelorMittal were not chemically coated and could possibly be used in constructing things. However, after benchmarking between other furniture and playground sets, we found that most of these products were made with a stronger wood. Therefore, we did not want to overstep any safety regulations with the quality of the wood pallets, so we ruled out that possibility.

Next, we were left with refractory brick. Since it is used in the process of steelmaking, we were concerned that the brick could have traces of metal. We found this to be true, through external research, and eliminated the idea of brick ovens for cooking. We were now focused on the reuse of refractory brick for things that are not necessary in produced goods for consumption, such as heated driveways and walkways.

Through concept selection, we decided that the best way to reuse the refractory brick would be to either sell it for repurpose or create products from it. However, this could be slightly outside of ArcelorMittal’s comfort-zone considering they are a steelmaking company. However, the two companies we found, Used Refractory and Orbit Radiant Heating, were perfect for the job. Used Refractory is a company based in Turkey that promotes the large-scale buying and selling of refractory brick (Used Refractory). Upon request, they will buy used refractory and resell it to those willing to buy. A great deal of companies will purchase this used brick to rebuild with it. For example, some companies take old refractory brick and grind it down to harvest the raw materials. These materials are used to make flint clay, silica fume, and several other important substances (Understanding Cement). The second company is Orbit Radiant
Heating, which specializes in outdoor heated sidewalk systems. Large companies are allowed to become distributors for Orbit Radiant Heating. We plan to introduce this idea for ArcelorMittal because it allows the brick to be repurposed. Also, there is a constant demand for brick in the sidewalk market, so they will always have a destination for the refractory brick (Orbit Radiant Heating). *We could not get an exact quote on the price that Used Refractory or Orbit Radiant Heating would offer ArcelorMittal due to lack of detailed company information.

UPS offers international shipping to anyone willing to meet a few requirements. ArcelorMittal would have to package the brick. We incorporated the pallets into our packaging design so that it allows two materials to be recycled. We found that Automated Stretch Wrapping machines are approximately $5,995 without a conveyor belt. To install a conveyor belt for better loading, it would only cost an additional $1,325. The other cost to the packaging process is the stretch wrap: $27 dollars for a roll which wraps 30 pallets. UPS recommends only wrapping the palletized cargo five revolutions worth. This is to promote a non-waste process and “cleaner” shipping. *We could not come up with a shipping cost because UPS requires an official, detailed request.

**Final Research (Testing Ideas):**

To test our project design and make sure it reaches our standards we plan to drive test runs of our shipping method. Our wrapping is very economical but to make sure it is useable we plan to make a twenty mile test run with the refractory bricks loaded into our design on the
shipping trucks. If the bricks are stable throughout the test run then they are suitable to be shipped to the companies. Barring any complications in the test run, more wrapping on the bricks can be used. Although from our research we predict that the current design, five revolutions of wrap, will hold up and will be able to ship the bricks to the companies without any problems (UPS Shipping).

To verify the final design of the refractory bricks being recycled into heatable sidewalks, we extensively researched the material and conductivity of the bricks. The material ArcelorMittal uses for their electric arc furnace and lining of the liquid steel ladles is a refractory brick different from building bricks and made with ceramic material. The conductivity of this refractory brick is .15 W/km (watts per kelvin per meter). This means that it is the perfect conductivity to be used as heating sidewalks. It will conduct enough heat to melt snow and ice and perform its task but will not be too strong to cause any adverse effects such as burning objects (Engineering Tool Box).

**Design For “Reusing and Recycling:”**

Our final design for reusing the brick will consist of the following:

We plan to package and ship the brick to Used Refractory and Orbit Radiant Heating. There are few additional packaging costs, however, ArcelorMittal will most likely make a profit from the endeavour.
Design for Packaging:

Our final design for packaging the brick will consist of the following:

We plan to install two automated wrapping machines with conveyor belts to make the packaging process as efficient and simple as possible. We plan to purchase the stretch wrap as needed so that money is not being wasted. If ArcelorMittal does not have a preferred way to ship, we suggest using UPS.

Waste Footprint:

By selling the used refractory brick to the companies Used Refractory and Orbit Radiant Heating, we will have successfully completed our mission statement and customer needs. By having the refractory bricks reused it will cut down on the waste footprint by using bricks that would normally be in landfills and causing pollution. Reusing these bricks is crucial in cutting down this company’s carbon footprint and having the company hold true to its sustainability mission. The only cost that comes to ArcelorMittal is the gas and packaging to transport the bricks to companies that will reuse them. One of the main reuses for the brick, heated sidewalks, will be beneficial to people by melting snow during winter months to provide safe walking paths. This will cut down on the amount of injuries due to slipping on icy sidewalks.
## Appendix:

### Concept Selection Tools:

Table 1: Concept Screening

<table>
<thead>
<tr>
<th></th>
<th>Outdoor Furniture</th>
<th>Gardening Accessories</th>
<th>Mulch</th>
<th>Sheds/Swingsets</th>
<th>Selling Refractory Brick</th>
<th>Heated Surfaces from Brick</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cost Effective</strong></td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>2</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td><strong>Sustainable</strong></td>
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<td>4</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
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<td><strong>Time Effective</strong></td>
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<td>3</td>
<td>4</td>
<td>1</td>
<td>4</td>
<td>4</td>
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<tr>
<td><strong>Doesn’t involve outside contractors (example: additional marketing and sales team)</strong></td>
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<td>1</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td><strong>Growing Purpose</strong></td>
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<td>1</td>
<td>4</td>
<td>1</td>
<td>5</td>
<td>5</td>
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<tr>
<td><strong>Total</strong></td>
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<td>19</td>
<td>8</td>
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Testing the Final Specifications:

Table 2: Final Specifications Test

<table>
<thead>
<tr>
<th></th>
<th>Reduced Waste</th>
<th>Cost Efficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Used Refractory</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Orbit Radiant Heating</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Packaging</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
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Costs:

- Undetermined Shipping Costs (UPS):
  - Includes everything from gas to international shipping!!!!

- Packaging:
  - Automated Wrapping Machines: $5,995 each
  - Conveyor Belt: $1,325
  - Stretch Wrap: $27 for 30 pallets
Flow Chart: Final Plan:

References:

(Used Refractory)


(Understanding Cement)


(Orbit Radiant Heating)


(Engineering Tool Box)