Analysis of recycling methods for contaminated metal chip considering approaches to eco-efficiency and eco-effectiveness

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Introduction

Generation of waste has become a challenge for management companies.

- Loss of input and organic matter
- High costs and environmental impact associated with the environmentally friendly disposal
Common practices found in the metal-mechanic sector is concerned with the remediation, recycling, and treatment during/after the waste is generated.

Is there any alternative?

Eco-efficiency

Developing technology to improve the production process, avoid generating waste, streamline processes and improve the utilization of raw materials and energy.

Eco-effectiveness

## Eco-efficiency and Eco-effectiveness

<table>
<thead>
<tr>
<th></th>
<th>ECO-EFFICIENT</th>
<th>ECO-EFFECTIVE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ORIENTATION</strong></td>
<td>Tends to promote actions with short-term results</td>
<td>Tends to promote actions with long-term results</td>
</tr>
<tr>
<td><strong>PARADIGM</strong></td>
<td>Reduction and minimization (cradle to grave)</td>
<td>Waste = nutrient (cradle to cradle)</td>
</tr>
<tr>
<td><strong>ASSUMPTION</strong></td>
<td>Linear flow materials</td>
<td>Cyclic flow materials</td>
</tr>
<tr>
<td><strong>INOVATION</strong></td>
<td>Tends to be incremental</td>
<td>Tends to be radical</td>
</tr>
<tr>
<td><strong>BUSINESS VISION</strong></td>
<td>Increases the product use longevity (repair, reuse, remanufacturing, recycling)</td>
<td>Sale of performance attributes and utility instead of just selling the product; new business models</td>
</tr>
</tbody>
</table>

Table 1 – Features of eco-efficiency and eco-effectiveness. Table source: Adapted from Lutkemeyer (2014).
Reuse Method – eco-effective approach (patent deposit - INPI)

- Surface area
- Volume
- Fusion efficiency

1. Dry the clean chip in greenhouse
2. Separate the chip from the effluent by filtration
3. Generation of the Contaminated metallic chip
4. Compact chip for fusion and reuse
5. Wash metal chip chemical reagent

ZERO WASTE
Total oil removal from chip;

High-grade reagent cleaning by distillation;

Aluminum machinability remelted > without generation of slag and soot > very close to the commercial alloys.

(DUTRA et. al, 2007)
Main Objective

• Evaluate the eco-efficiency and eco-effectiveness of the methods used in the cleaning of metallic chips contaminated with cutting fluid metallurgical enterprises.
Methodology

Analysis of waste reuse methods of metal chips > choose the method considered more eco-effective to be used as control > chosen method designed and executed by Dutra et al [9];

Diagnosis of reuse in loco aluminum chip waste into three companies located in Porto Alegre - RS, the metal-mechanic industry that have the same type of waste for comparison of the methods employed > qualitative approach to Environmental Management System of the companies studied (A, B, C);

Analysis of the different practices presented by companies "A", "B" and "C" > identification of eco-effective and eco-efficient approaches in each method > evaluation and comparison of the methods in the control method.
## Results and Discussions

<table>
<thead>
<tr>
<th>COMPANY</th>
<th>GENERATION (TON/MONTH)</th>
<th>DESTINATION</th>
<th>TREATMENT BY GENERATION COMPANY</th>
<th>ENVIRONMENTAL IMPACT</th>
</tr>
</thead>
<tbody>
<tr>
<td>COMPANY A</td>
<td>55</td>
<td>Sell waste for metallurgy that will remelt of chips</td>
<td>There is not</td>
<td>Significant</td>
</tr>
<tr>
<td>COMPANY B</td>
<td>19</td>
<td>Sell waste to smaller company in order to gather more quantity and sell for metallurgy that will remelt the chips</td>
<td>Oil flow in bucket in order to sell the cleanest metallic chip (previous treatment before remelting)</td>
<td>Significant</td>
</tr>
<tr>
<td>COMPANY C</td>
<td>02</td>
<td>Pay for third party collect the residue, making the necessary treatment and disposal in landfills</td>
<td>There is not</td>
<td>Significant</td>
</tr>
</tbody>
</table>

Table 2 – Data collection in the companies interviewed. Table source: The Authors (2015).
Figure 1 – Comparision between the control method and the observed methods.
Eco-effective practices in the industry:

- positive results for the development of sustainability;
- environmental improvements (leaving extracting raw material and avoiding pollution);
- reduction of costs (waste disposal);
- economic increase (leaving buying and producing the raw material itself).
• But this approach is not yet fully deployed in companies since only the control process has all stages of the metal chip recycling process as **eco-effective**;

The methodology was effective = was possible to identify the methods analyzed eco-efficient and eco-effectiveness approaches
Practices and concepts of eco-effectiveness approaches must be addressed by literature and adopted by the companies, since in the long run, bring environmental and economic benefits.

Still processes with eco-efficient practices are better compared to processes that do not have any sustainable practice.
References


THANK YOU!

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