“Using the method adapted TRIZ as a tool to support the implementation of Cleaner Production”

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National Cleaner Production Centre SENAI
Established in 1995. CNTL was the tenth NCPC implanted in the world and the first in Latin America.

42 NCPCs established all over the world
National Cleaner Production Centre of Brazil  SENAI

- FIERGS - Agency of industries of RS
- SENAI - Professional Education and Technological Services
- CNTL - Environmental issues and CP
National Cleaner Production Centre of Brazil  SENAI

Environmental Solutions offered to Companies

- Cleaner Production implementation / methodology
- Industrial Solid Waste Management
- Environmental Passives
- IMS 9001/14001/18001, ISO 14001,
- OHSAS18001
- Environmental Diagnosis
- Environmental Audits
- Materials Conformity Audits
- Legal Compliance Audits
- Ecodesign
- Technology evaluation
- Projects for Effluents Treatment
- Stations
- Due Diligence
- Toxicity survey
Cleaner Production implementation / methodology

Context: Toys and industrial components manufacturer

Step 1 - Planning and organization
- Define the scope
- Identify barriers and solutions

Step 2 - Pre-Assessment and Diagnosis
- Select the focus of the evaluation

Step 3 - Assessment
- Generate options for Cleaner Production
- Select options
- Economic Evaluation
- Environmental Assessment
- Select options

Step 4 - Feasibility Study
- Monitoring and evaluate
- carry on activities of cleaner production

Step 5 - Implementation
- Prepare the implementation plan
- Implement the options for cleaner production
- Technical evaluation
- Preliminary Assessment
- Carry a balance of material and energy
- Conduct an assessment of causes

Get the managers’ commitment and involvement
- Establish the project team
- Develop process flowcharts
- Assess the inputs and outputs
Cleaner Production implementation / methodology

Context: Toys and industrial components manufacturer

- Natural Wood
- Toys
- Rotomolding
- Metal components
- Office Activities
Cleaner Production and TRIZ

1. Get the managers’ commitment and involvement
2. Establish the project team
3. Develop process flowcharts
4. Assess the inputs and outputs
5. Carry a balance of material and energy
   - Conduct an assessment of causes
6. Preliminary Assessment
7. Technical evaluation
8. Prepare the implementation plan
9. Implement the options for cleaner production

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TRIZ
Theory of Inventive Problem Solving
Steps for solving problems in TRIZ Method Adapted

1. Real Problem
2. Generic Problem
3. Generic solutions
4. Particular solutions

Abstraction

40 inventive principles

Application
The 40 inventive principles were obtained by generalization and grouping solutions repeatedly used in the creation, development and improvement of technical systems of different areas. These solutions were analyzed based on a large number of patents. They suggest some solutions for certain types of problems at the level of abstraction, which can be interpreted and transformed into a real solution.
### Matrix of Contradictions

<table>
<thead>
<tr>
<th>Peso (resultado)</th>
<th>Peso (objeto)</th>
<th>Controle do material</th>
<th>Controle do objeto</th>
<th>Área (resultado)</th>
<th>Área (objeto)</th>
<th>Volume em fita</th>
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**39 engineering parameters – undesirable results (conflict)**

**Inventive Principles to be applied**

*total = 40*
Rotomolding Process

1. Charging
2. Heating
3. Cooling
4. Demolding

Root of waste:
- generation of scrap;
- product quality problems;
Identifying the real problem and its main cause

**Concrete Problem:**
Generation of scrap and nonconforming product in the rotational molding process

**Consequences:**
- Need for warehouse space
- Cost of hand labor and energy in the recycling of waste;
- Loss of material properties;
- Difficulty of reprocessing

**Why I want to solve this problem?**
- Reduce the costs to the company

**What is preventing you from solving this problem?**
- Difficulty of finding efficient insulating material
- Unfavorable geometry

**Causes:**
- Cause 1: Geometry Product
- Cause 2: process characteristics
- Cause 3: difficulty managing the different temperatures in the mold
- **Cause 4: difficult in thermal insulation**
Matrix of Contradictions and possible solutions to the problem

The contradiction formulated for the specific problem "Generation scrap and nonconforming product in the rotational molding process" is: If characteristic **LOSS OF SUBSTANCE** is improved with the process of turning the mold for example, then the characteristic **EASE OF OPERATION** will worsen due to the difficulty of supplying the mold and clogging the valve.

<table>
<thead>
<tr>
<th>Feature to be further improved (Parameters Engineering)</th>
<th>Feature that worsens (Parameters Engineering)</th>
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<tbody>
<tr>
<td>23. LOSS OF SUBSTANCE</td>
<td>33. Ease of operation</td>
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<tr>
<td>2. extraction</td>
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<td>4. asymmetry</td>
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<td>28. Replacement of mechanical system</td>
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<td>32. Color change</td>
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**Real solution**: isolation of some parts of the mold in the rotational molding process, thus avoiding loss of material due to temperature problems / isolation.

Interpretation

- Extract the "disturbing" part or characteristic of an object.
- Extract only the necessary part or property of an object.
Results

Generation of scrap: A project was developed to apply thermal insulation in parts of the existing mold. There was a 77% reduction in the generation of scrap in this product. This scrap reduction provides an annual cost savings of around R$ 23,000.00, avoiding the consumption of 6.376 kg of virgin plastic (Polyethylene Linear Medium Density) also the reduction of energy consumption in grinding scrap and labor.

+ complementary actions improvements to reduce scrap by 89%

Only one product, the rotomolding process has 270 different products in this company
**Results**

**Generation of nonconforming product:** improvements were developed in the air outlet valve and in the material cover coating from the mold. Such actions have been implemented in existing mold and have the potential to reduce the generation of waste by 30%, which represents an economic benefit of R$ 13,000.00 / year and reducing consumption of 2,912 kg of virgin plastic.

A new mold will be produced with this improvements and will bring a 50% wastes reduction and a payback of less than two years.
The mix of cleaner production with the method adapted TRIZ was positive, although it wasn’t the only factor responsible for the development of the solutions. The expertise of the working group was a key element, being enhanced with the introduction of the adapted TRIZ.
Thank You!

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