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THE PRELIMINARY ENVIRONMENTAL ANALYZE CONCERNING ISO 14000 FOR A FOUNDRY THAT USE LOST-FOAM TECHNOLOGY

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ABSRACT
The paper presents the main steps for realize the basic environment analyze for implementation of the environment management system for a foundry that use Lost Foam technology. It is a conceptual presentation of the environmental aspects identification and the impact of this technology over the foundry.

1. THE SUSTAINABLE DEVELOPMENT

The total eschewal of the environment degradation generated by the human activities it is impossible, but it is possible to realize some actions those decrease the negative impact of these activities over the environment.
In human attention for obtaining better life conditions departure of the environment protection problems passed few stages from the awaken that the increase of the goods production supposed an increase of the waste quantity (at the beginning of the 60's) to the "**cleaner production**" concept, sustainable development and integrated actions in to the production technologies (dominant preoccupation for 90's).
The **sustainable development** concept was the central point of discussions concerning the development and the environment in 1987 after the publication of the "The World Commission on Environment and Development" 's report *Our Common Future*.
In 1992, the Rio Declaration of Environment and Development – that presents the principles concerning to the interactions between humans and environment – starts the acknowledgement of the sustainable development concept. There, the international agreement and the adopting of the Agenda 21 established the global strategic option for 21st century.

2. THE ENVIRONMENT MANAGEMENT SYSTEMS

For practices applying of the sustainable development concept are necessary three working levels: industrial, governmental and international.
Industry is the main element that concern to satisfying the human necessities and it is a base for goods production and pollution.
Solving the problems of the industrial pollution could be done considering different solutions:

- ***Using the cleanest technologies*** (or the best available technologies BAT) – these

technologies benefit by the low energetically consumption, low consumption of utilities and raw materials, have high capability to transform the raw materials, improve the quality of the working conditions and have a low negative impact over the environment;

- ***Using the environment standards*** – these standards were occurrence starting from 1990 when International Chamber of Commerce (ICC) publishing the 16 principles of the environment management;
- ***Using politics and appropriate environment legislations.***

Certainly, the environment protection must be integrated in to the sustainable development, and the development is easiest to monitoring using politics and appropriate legislation applying in to the industrial companies.
By itself, the environment management system (EMS) represents a methodically tackling of some problems those permit to an organization to achieve the environment aims and all other targets.
On the international level are known and implemented environment management systems considering three standards:

- ***BS 7750 (from 1993)*** – it is the British Standard and it was the standard dedicated to the environment management systems;
- ***EMAS (1^{st} in 1993 and 2^{nd} in 2001)*** – it is the European Standard known as Eco-Management and Audit Scheme and it was published in to EEC No. 1836/93 from the 29^{th} June 1993, reviewed and republish as EMAS II in 2001;
- ***ISO 14000 (in 1996 and republish in 2004)*** – it is an international standard dedicated to the environment management system. Now, it is the most used standard through its high flexibility and adaptability.

A certified EMS proves that the company is informed about it legal obligations concerning to the environment protection and the company is in process of applying them. By using thus EMS it is not certifying that a company (a foundry, for example) realizes a zero pollution of the environment; it is certified that are considered all the necessary actions so that the impact over the environment generated by the company's activities and products to be as low as possible and the company commit oneself to respect the current environment legislation.
Doesn't matter what kind of EMS is implemented it is destined for reducing the impact over the environment and improve the environment performance.
The first step for realizing an EMS it is the preliminary analyze for implementation. The aim of this analyze is obtaining the information about the company condition on that moment for could use these information like reference for future analyzes.

3. THE ENVIRONMENTAL ASPESCTS IN TO THE FOUNDRIES

Usually, the foundries operate in to industrial area with dens population. The infrastructure of the casting parts production is an open system that involves large quantities of materials and products with so different physical and chemical properties and 20° – 1600° C temperature range. These elements generate quite important quantities of different kind of waste in different state of aggregation.
Considering these aspects, it is necessary a detailed analyze of the casting technologies from the environment point of view for identification the main pollution sources, the potential impact over the environment and at last but not at least for identification the best available technologies.
For determination the main pollutant elements in to the foundries it was performed a detailed analyze of all existing technological processes. Analyze were performed in to 6 foundries in Cluj-Napoca (Romania) in different stages during 2 years. The analyzed foundries have different production capabilities, but used the same classical technologies for molding, casting, knocking out of mold and smelting condition, used the same raw materials for

molding and alloy smelting and the casting parts could be included in the same class.
The analyze was realized from input – output point of view starting by identification and the analyze of the insets of raw materials, materials, products and spin-off products, utilities (electrical energy, methane, industrial water, compressed air, etc), of the existing endowment. In this way it was realized a diagram containing all the necessary information.
The result of this analyze, performed for each foundry, was the identification of the specifically activities potential pollutant (working areas, fabrication processes) and the possible environment aspects. The selection of an identified environment aspect that being significant was made only after performing specifically laboratory tests, determination of the risk, the appearance frequency and comparison the results with data containing by the current legislation.
Table 1 presents the results of analyze concerning the identification of the main significant possible environment aspects. It is shown the working area where the environment aspects were identifying and the possible elements those generated it.

Table 1. The Main Significant Possible Environment Aspects.

	Significant possible environment aspect	**Working area where could exist**	**Possible elements those generated it**
1.	Suspended powders	Smelting	1. Packaging, handling and improper prepared of the raw material; 2. Untight and faulty function working equipments; 3. Inaccurate working procedures;
		SPAF, SPAM	
		Molding	
		Coring	
		Knock-out	
		Cleaning	
2.	Ignition gas (CO, CO_2, SO_x, NO_x)	Smelting	1. Incomplete ignition of the ovens fuel; 2. Inaccurate working procedures;
3.	Smoke / Toxic gas (another then ignition gas) Ex. VOC and HAP	Smelting	1. Using unscreened and improper prepared raw material 2. Using modifiers and degasification materials 3. Untight and faulty function working equipments 4. Inaccurate working procedures
		SPAF, SPAM	1. Caused by chemical compounds of used materials and specifically chemical reactions 2. Untight and faulty function working equipments 3. Missing the ventilation systems or it faulty function 4. Inaccurate working procedures
		Molding	
		Coring	
		Casting	
4.	Noise and vibrations	Smelting	1. Ancient working equipment with faulty function and improper fixing in to the working area 2. Improper sound insulation of working equipment 3. Inaccurate working procedures
		Molding / Coring	
		Knock-out / Cleaning	
5.	Thermal radiation	Smelting	1. Improper thermal insulation of working equipment 2. Inaccurate working procedures
		Casting	
6.	Slag	Smelting	1. Improper and uncontrolled storage 2. Inaccurate working procedures
7.	Used or improper molding and coring compound	SPAF, SPAM	1. Improper quality of raw materials 2. Improper and uncontrolled storage 3. Inaccurate working procedures
		Molding	
		Coring	
		Knock-out / Cleaning	

Note:

SPAF – Molding compound preparing area
SPAM – Coring compound preparing area
VOC – Volatile organic compound
HAP – Multi-ring aromatics hydrocarbon

Even if it could not be considered a significant environment aspect it must bear in mind that inside the foundry are consumed a great quantity of electrical energy, natural gas and another fuels. For this reason any analyze get for renewing the technologies or implementing of an EMS must consider these technologies those decrease the energetically consumptions, the materials and raw materials, the any kind of waste and emitted in to the atmosphere a lower quantity of toxic products (suspended powders, gas, aerosols).
For these reasons it was developed new casting technologies those try to satisfy these aims, but, until now, it was not find a technology that occur all of it. The Lost-Foam casting technology could be included in to the group of new casting technologies those benefit by the low energetically consumption and decrease the costs and the quantity of the raw materials.

4. THE LOST-FOAM TECHNOLOGY

The principle of the Lost-Foam casting technologies is relatively simple and supposes the manufacturing of a model using a foam, manufacture the by covering of the model using refractory material, consolidation of the cover and pouring the liquid alloy in to the mold over the foam model. Considering the type of the refractory material and characteristics of the mold are available two alternate technologies:

- **FM (FULL MOLD)** – it is similar with classic sand casting technology. The model is fixed in to a molding box using sand, metallic pellets, molding compound, molding compound for freeze mold, etc
- **CS (CERAMIC SHELL)** – it is similar with Investment casting technology and supposes to manufacture a refractory shell that covers the foam model. In this case the eliminating of the model are made by calcinations of the shell before the pouring of the liquid alloy.

The technology has many particularity and advantages and that is the reason why it is frequently used especially for machine building:

- It is useful for large scale series production or for batch production
- Could be cast ferrous and nonferrous alloys
- The position of the model during the molding and casting is not very important
- It is possible to cast different parts in the same molding box
- The usage factor of the liquid alloy increase because the feeders dimensions are lower
- The sand consumption decrease and the cores are not necessary
- The exogenous gas holes will not appear the permeability of the mould is high
- The appearance frequency of the shrinkage hole is decrease
- The surface quality of the casting parts depends only by the surface quality of the model

Seems like any other process, Lost-Foam technology has few disadvantages:

- The models are using for one casting only
- The equipments necessary for manufacturing the models are quite expensive
- It must be strictly respect the working procedures
- It are necessary specifically laboratory tests
- Could appear ecologically problems, but these problems could be solved

4.1. The SWOT analyze of the Lost-Foam Casting Technology

A very useful management device for appreciate an activity is the SWOT analyze. The utility of the SWOT analyze for the Lost-Foam Casting Technology is quite important because it help the company to identify the strengths (and exploit it) and the weaknesses (and eliminate

it). Also, this analyze allows obtaining the external information comparison the technology by other current existing technologies.

Table 2. The Swot Analyze

	Strengths	Weaknesses
INTERNAL	• Increasing the quantity of the raw materials; • Increasing the quantity of auxiliary materials; • Increasing the energetically consumption; • Increasing the manufacturing cost; • The flexibility of the manufacturing; • Good handling equipment and automation possibility; • Increasing the noise and vibrations level; • Increasing of the manufacturing cycle;	• The quality of the final part depend first of all by the quality of the model; • Indispensability of the strictly technological control; • The resulted gas are toxic;
	Opportunities	**Threats**
EXTERNAL	• The technology could be considered a cleaner technology that apply the sustainable concept; • The problems generated by the waste provided by the molding compound are eliminated; • Easier access at capital for future investments	• It is necessary an intense preoccupation for purchasing the equipments for retaining and neutralization of the resulted gas; • It is necessary a permanent monitoring of the employees health;

4.2. The Impact of the Lost-Foam Casting Technologies over the environment

Considering the environment conditions from the sustainable development concept it was necessary an environment impact analyze of the Lost-Foam Casting Technologies. The paper presents the analyze for FM technology only.

It is not possible to appreciate if this technology is more or less pollutant until are not analyze the specifically technological insets and the fabrication stages considering all their particularity.

The technology has many particularity and this is the reason why it is necessary an environment analyze of these particularities for could be identified all the impacts (positives or negatives) over the environment.

Table 3. The Influences of the Particularities of the Lost-Foam FM Casting Technology Over the Environment

	Analyzed area	Particularity	The impact	Observations
1.	**SPAF**	•The binder are not used; •It is used wash and dry sand only; •In this area will be done the storage and the transport of the sand;	• This area will be eliminate from the foundry structure; will be storage area only; • The consumption of the raw materials will decrease because will be not used binders and auxiliary materials; • The electrically energetic consumption will decrease because will not be used processing equipments; the necessary equipments has low electrically energetic consumption; • It is possible to appear suspended powders provided by the handling of the sand;	$S_u \downarrow$ $C_{mp} \downarrow$ $C_{ee} \downarrow$ P_s
2.	**SPAM**	The cores are not necessary;	This area could be completely eliminate	$S_u = 0$ $C_{mp} = 0$ $C_{ee} = 0$
3.	**Alloy smelting**	Will be modify the dimensions of the pouring gate	• The consumption of the raw material and liquid alloy will decrease because the pouring gate has modified • Will decrease the electrically energetic of fuel consumption	$C_{mp} \downarrow$ $C_{ee} \downarrow$

4.	**Pattern maker's shop**	• It are used plastic materials; • The models are light; • The number of the models are equal with the number of the casting parts;	• The wood and it waste are eliminated • The models material is easy to manufacture • The necessary equipments have electrically energetic consumption and dimensions lower than wood manufacture equipments • It are necessary good ventilated areas for storage the models until molding • Could appear gas provided by manufacturing and storage of the models	$S_u \uparrow$ $C_{ee} \downarrow$ G
5.	**Molding**	• It is eliminated the manufacturing of the mold; •It are used molding box; •The cores will be eliminated; •The mold will be vibration ramming;	• The molding costs are decrease (by elimination of the cores) • The noise level will decrease • The energetic consumption will decrease; • Could appear vibrations on the ramming tables; • It is possible to appear suspended powders provided by the handling • Of the sand;	M ↓ Z ↓ $C_{ee} \downarrow$ V P
6.	**Casting**	The reinforcement system of the mold will be eliminate	• The energetic consumption will decrease because some equipments are not used; • Will appear toxic gas provided by the defoaming of the polystyrene;	$C_{ee} \downarrow$ G
7.	**Solidifying and cooling**	In this area will not appear significant modifications	It is necessary to use an exhaust system for evacuate the gas provided from casting and solidifying;	G ↑
8.	**Knock-out**	Will be done by simple turning of the molding box;	• Low costs; • The energetic consumption will decrease; • All the sand could be recover and reused; • Will appear toxic gas;	M ↓ $C_{ee} \downarrow$ $R_m \uparrow$ G
9.	**Cleaning**	Will be eliminated the cast seams and the adhesions;	• Low costs • The energetic consumption will decrease • The material of the pouring gate and the feeders is recycling	M ↓ $C_{ee} \downarrow$ $R_m \uparrow$
10.	**Sand regeneration**	• All the sand used for casting will be regenerated • For regeneration are available two methods: thermal and wet	• All the sand used for casting will be regenerated (will be lost maximum 2%) that involved the decrease the raw material consumption • The waste provided by the mold and core compound will be eliminated and will be solved some environment problems	$C_{mp} \downarrow$ D = 0

Note:

S_u – the surface of the analyzed area
C_{mp} – the raw material consumption
C_{ee} – the electrically energetic consumption
P_s – suspended powders in to the working area
G – gas in to the working area
M – cost
Z+V – noise and vibrations
R_m – recycled materials
D – waste from molding and coring compound

4.3. The Identification of the Environment Aspects of the Lost-Foam Casting Technology

For the identification of the environment aspects of the Lost-Foam casting technology it was analyzed all technological inset in all it stages. Figure 1 presents the results of this analyze. Testing in to the Casting Laboratory of Technical University of Cluj-Napoca identified all the environment aspects.

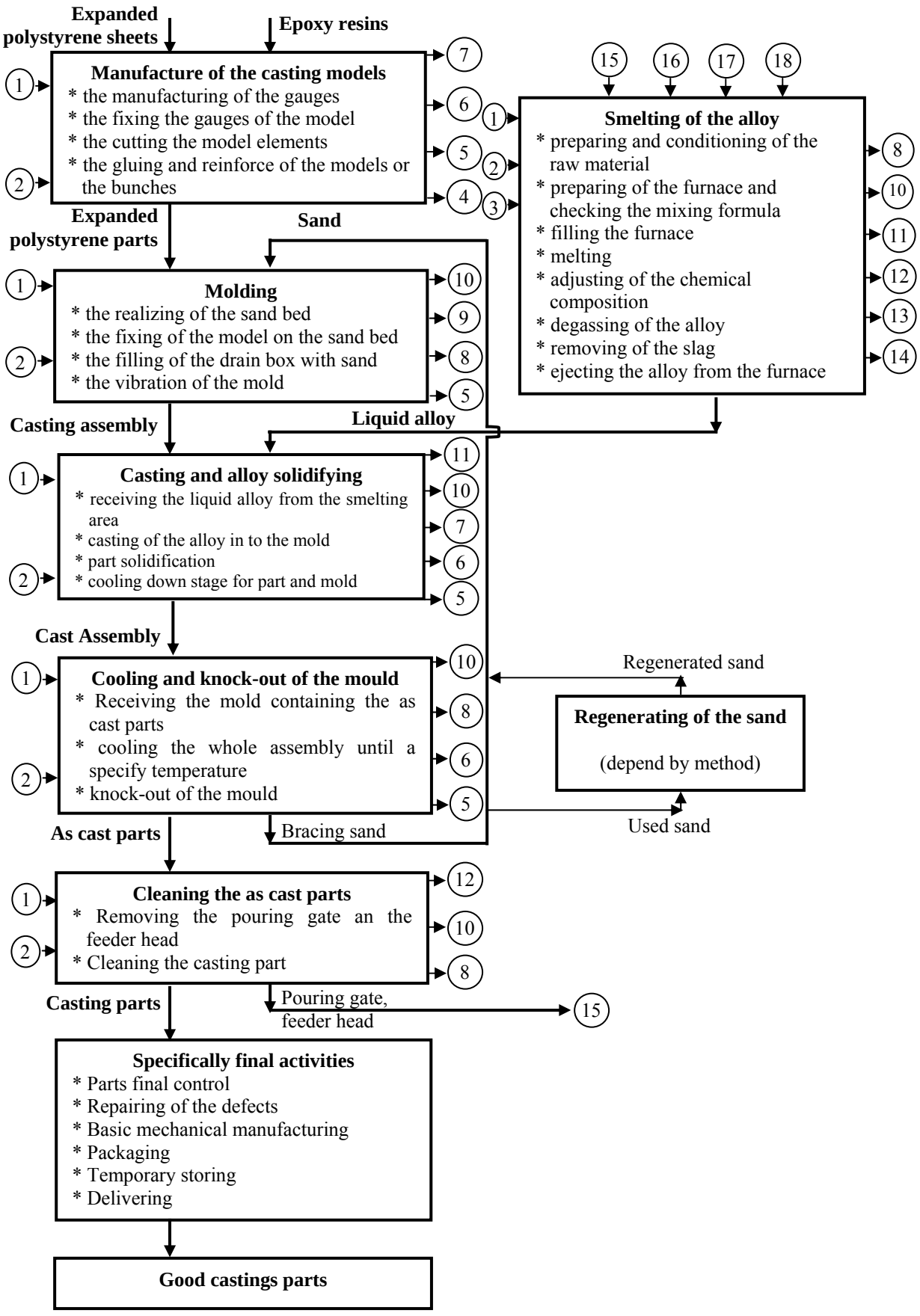

Figure 1. The Result of the Input-Output Analyze of the Lost Foam Casting Process – Full Mold Method

Note
1. Electrical energy
2. Compressed air
3. Methane
4. Polystyrene waste
5. Gas (VOC and HAP)
6. Smoke and aerosols
7. Ash
8. Suspended powders
9. Dust
10. Noise and vibrations
11. Thermal radiation
12. Vapors and gas
13. Ignition gas
14. Slag
15. Recycled material
16. Hardening alloy
17. Auxiliary materials (modifiers)
18. Stamping materials

5. CONCLUSIONS

- This technology could pay attention because it has a wide rage of applications and benefit by some particularities those impose it seems like a low pollutant technology that could be included in to the best available technologies
- Performing the analyzes from this point of view allow to obtain the information concerning the impact of the Lost-Foam casting technology over the environment and the humans and could be precisely identify the pollutants and what kind the pollution will be achieve
- For a company that use this technology and want to obtain a certification for EMS it will be useful an integrated approaching of the environment problems and the occupational health. Considering these, a company could implement in the same time both systems: ISO-14000 for environment management system and OH SAS 18000 for occupational health and safety.

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