REVERSE LOGISTICS SYSTEMS IN A STEEL MILL A FULL PRODUCTION CYCLE

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Abstract

An important problem associated with the production of steel products is the need to ensure adequate protection of the environment. Throughout the technological foundry formed about 90 types of waste, while a significant number of them belong to a group of hazardous waste. Resulting in the production system have a steel mill waste utility value to justify the economic and ecological use, not only in the steel sector but also in other sectors of the economy. There is a need to increase activities related to environmental waste management from manufacture of steel, particularly those whose development is one way of storage. The paper presents the concept of reverse logistics in the specific example of a steel mill a full production cycle.

Keywords: steel plant, waste utilization, logistics system

1. THE LOGISTIC APPROACH TO THE PROBLEM OF WASTE MATERIAL

Production of steel in the world is in the last 5 years, very variable (for example, in 2006 - a 247.2 mln Mg crude steel, 2007 - a 346.1, 2008 - a 327.2, 2009 - 1 229.4, 2010 - 1 413.6 mln Mg) [1]. According to data reported annually in the World Steel Association reports continues to grow production in China (in 2006 - 419.1 mln Mg crude steel, 2010 - 626.7 mln Mg). Polish steel mill producing for ArcelorMittal also to note the large fluctuations (2006 - 10.0 mln Mg crude steel, 2007 - 10.6, 2008 - 9.7, 2009 - 7.1, 2010 - 8.0 mln Mg). Still, the world needs a lot of steel, and thus created a lot of different wastes. An important problem associated with the production of steel products is the need to ensure adequate protection of the environment.

Productive waste material are the undesirable occurrence, hence the tasks of the logistics of the repeated utilisation of metallurgic waste material should be activities pursuing of the minimization of the quantity of nascent waste material, and also to their full utilization by means of the reusing in metallurgical processes, or in the other branches of the economy ( [2]. In addition, it is very essential to keep the suitable proportions among ecological and economic aspects [3]. Over 90 kinds of waste material is generated in the whole technological processes of the steelworks, and mostly there are waste material undesirable for the environment, containing - among other things - oils, heavy metals (Mn, Pb, Cr, Cd, Zn, Cu, Ni, Al), asbestos, phenols, bituminous matters [4]. During the last years, in the metallurgy, the considerable degree of these waste material utilization has been reached - exceeding 90% of their total quantity. The operational point of view of the logistic activities in the steel plant should then include the logistics system consists of: supply, production, distribution and the repeated utilization of wastes. While aspects of the logistics of the supply limit themselves to reduce pollution of the environment both on the entry and the exit side of the manufacturing process, this the logistics of the repeated utilization of waste substances contributes to solve ecological problems in the environmental protection [5].
According to the logistics of the repeated utilization of wastes (the logistics of the recirculation), all substances nascent in the production process, which are not purposely manufactured products, are being qualified as, so called, remains. As the repeated utilization of wastes one ought to understand - according to [6] - "...the use of the idea of the logistics with reference to remains, for only to cause economically and the ecologically efficient transfer of remains, with the simultaneous spatially - temporary transformation, inclusive with the change of the quantity and the sort".

One can then conclude (in reference to definition of the logistics) that the logistics of repeated utilization of waste materials is a system, which:

- bases on the integrated idea of planning, management and control of waste materials (solid, liquid and gaseous) flows as well as the related information,
- assures the readiness and the ability of neutralizing or the liquidation of waste-materials according to accepted technical and technological rules, which ought to meet standard and legal regulations concerning environmental protection,
- enables making decisions leading to minimizations of the quantity of waste material accompanying the production, distribution and consumption processes.

One of the major concerns of world steel industry is the disposal of wastes generated at various stages of processing. The global emphasis on stringent legislation for environmental protection has changed the scenario of waste dumping into waste management [7]. Remains - depending on the possibility of reuse or further treatment - are divided on the secondary utilised raw materials (available to the direct reuse) and the other waste material, which can occur in the form of the constant, liquid and gaseous phase. These interdependencies for steel mills are shown in figure 1.

The fundamental definitions of logistics have evolved considerably in recent years. From the point of view of the tasks of logistics it is worthwhile to defer to the definitions contained in The Council Supply Chain Management Professionals (CSCMP) Glossary of Terms, which slightly differs from some European definitions (e.g. ELA). The following description of the objects of logistics and of logistics management demonstrate this quite clearly.

According to the European Logistics Association- ELA; (2005): Logistics – it is the management of processes of goods and/or persons transfer together with activities supporting these processes in systems in which they occur. Systems, in which these processes (of goods and/or persons transfer) appear are both economic systems - whose activity is profitably oriented (industrial enterprises or commercial companies together with the delivery/supply chains) – as well as the non-profitable systems (the public medical service, the public education, municipal systems, environment or surrounding systems).

Objects of logistics are physical goods such as raw materials, preliminary products, unfinished and finished goods, packages, parcels, and containers or waste and discarded goods [8]. Logistics management is the part of supply chain management that plans, implements, and controls the efficient, effective forward and reverse flow and storage of goods, services, and related information between the point of origin and the point of consumption in order to meet customers’ requirements [9].

2. THE LOGISTIC SYSTEM OF THE WASTE DISPOSAL IN THE METALLURGY

Solving the problem of waste management is possible by the metallurgical processing of complex steel mills, as a system of interdependent units-departments, businesses and relations between the steel plant and the environment [10].
Fig. 1. Relationship in the logistic system of waste disposal

LSGO

Waste stream

Information System

Waste stream

Recovered waste products

Neutralised waste products

Warehoused waste products

Stored waste products

Transferred waste products

Equipment

Technologies

existing

projected

existing

possible

at concept phase

Raw material for another branch of economy
The LSGO system one can define taking into consideration the controlled working system SR, the master, controlling system (management) SZ, the information system SI and R_{R,Z,I} relations, existing among these systems:

\[
\text{LSGO} = < \text{SR}, \text{SZ}, \text{SI}, R_{R,Z,I} >
\]

The working system SR (controlled), in addition, ought to take into account the following subsystems:

- SSG system - storage and gathering of waste material,
- ST system - transportation of waste material,
- SU system - utilization (processing) of metallurgical waste material.

\[
\text{SR} = < \text{SSG}, \text{ST}, \text{SU}, R_{SG,T,U} >
\]

The SZ managing (controlling) system takes into account the management systems of: transport (SZT), storage (SZS), production (SZP), distribution (SZD), marketing (SZM), and the system of costs (SK), so then:

\[
\text{SZ} = < \text{SZT}, \text{SZS}, \text{SZP}, \text{SZD}, \text{SZM}, \text{SK}, R_Z >
\]

whereas, R_{Z} represents the relation among above mentioned systems.

Waste material entering the LSGO system from the production system and other subsystems, are the input data.

The output data from the LSGO system are [11]:

- secondary raw materials, directly available for reuse in steel plant,
- raw materials useful for the other branches of economy (after previous processing in the steel plant or by specialised companies, on a base of an "outsourcing" contract),
- selectively gathered and stored waste materials, for which up to now, there are not economically well-founded methods of their utilization (e.g. sludge containing iron) or also at present there is lack of the technology of their utilization.

One of the important systems significantly influenced onto the success of the undertaking activity is the data system, and particularly the system of information technology, which ought to take into consideration the legal regulations of the Waste Material Act, and also the local conditionings and recommendations in relation to waste material utilization (outsourcing realised by external firms). The system should possess at least the local area network LAN, which should make possible connection between the separate departments of the steel plant as well as with the outsourcing companies, carrying out the waste material utilisation. Nowadays, an additional arduousness in proper prognosis of the waste material utilization is the variable quantity of the total steel industrial output and consequently the variable volume of waste material. For the present mill was built a global database on waste, as well as databases for individual departments.

The computer-processed information structure of the waste utilization system is presented in figure 2. Taking into account the need of computer-processed information for purposes of the widely understanding management and the production controlling (MRP, ERP systems) it seems that such a problem is very essential for the proper exploitation of the steel plant. Within the range of waste disposal an open question is the problem of purchasing of the expensive software accessible on the market, or else - the our own software creation.
3. CONCLUSION

At present in steel plants about 750 - 850 kg of the different kind of waste material form per one Mg of the produced steel and at this point in time approximately 90% of that waste material amount is being utilised. The following undertakings are essential to ensure the efficient management of the waste disposal in the metallurgy:
1. Elaboration of the waste material utilization programme to fulfil the formal requirements:
   - the programme concerning minimization of waste material forming,
   - disposal projects of industrial waste stockpiles (new technologies and users),
   - the specification of external receivers (the outsourcing).

2. Marketing activities intensification (receivers finding) for increasing of the degree of waste material disposal or utilization outside the steel plant ("the outsourcing").

3. Verification of contracts with waste disposal companies for the improvement of output, storage and disposal of waste material.

4. Implementation of the proper computer system supporting management of processes of the waste material repeated utilization (it is necessary to establish the global database of waste material, on the basis of classification sheets – in accordance with the Waste Material Act).

5. Installation of the technological line for transformation (for example: briquetting) the iron-bearing waste material, i.e. the utilization of a several percent of remaining waste.

**LITERATURE**