

## **PROCESSING, UTILIZATION AND DISPOSAL OF WASTE IN THE STEEL INDUSTRY IN ISFAHAN, IRAN**

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**Key words:** *Steel industry, waste disposal, blast furnace, Isfahan, Iran*

### **Abstract**

Environmental pollutions are in considerable attention in steel industries in Iran, where mostly are located around Isfahan. Therefore, an investigation has been done mainly on the industrial pollution and waste related to the Isfahan Steel Complex. Installation of a plant to collect the uncontrolled fumes, gases and particulates from blast furnace number II during tapping. This plant collects about 2 tons of dust each shift which previously were directed into the atmosphere. The efficiency of the system is going to be improved with some correction currently under way. Asbestos was used very widely for different purposes (about 124 tons per year) as powder, sheets, ropes and woven materials. In steel ladles, preheating furnaces of rolling mills and the power generating plant, asbestos is used as a heat insulator. The small amount of asbestos still being used is kept strictly under control and asbestos and waste is disposed of in a suitable manner. Blast furnace slag is used in the cement industry and construction works and in the slag wool plant especially built for this purpose close to the complex. Efforts have been made to replace dangerous solvents like carbon tetrachloride and other hazardous organic solvents with less toxic ones. The environmental management emphasizes the maintenance and repair of electrofilters, venturi scrubbers, bagfilter houses, multicyclones and other means of pollution control which almost all are under way. The use of a venturi scrubber with an adjustable throat is being considered to enhance the efficiency of the converters. Converter slag and other waste containing chemicals including cyanide ions are the main subjects being examined at present.

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## Introduction

Most steel products are made, address various environmental aspects of the following segments of the iron and steel industry : ore mining and preparation, coke preparation, pig iron production in the blast furnace, direct reduction, steelmaking in basic oxygen, open hearth and electric arc furnaces, and finishing operations including continuous casting, hot rolling, cold rolling, wire drawing, and acid pickling. Each process uniquely affects air and water quality and creates particular solid waste disposal problems (6).

This article will address the environmental concerns of the Isfahan Steel Complex in Iran, with waste minimization and treatment technologies that can reduce its impact on the environment.

Out of the three large government owned steel complexes in Iran, the Isfahan Steel Plant is the first integrated Plant in operation since 1971. The main departments are blast furnaces, coking refractory processing, steel making and rolling mills. Other necessary departments and services are also incorporated. Annual production is about 2,400,000 tons of long products mainly used in construction works. Obviously, there are some by-products that they will be referred to later (3,4).

The second largest steel company in Isfahan Province, Mobarakeh Steel Company, started producing flat products with direct reduction technology (midrex) and annual production of 2.4 million tons per year in full operation and now 1.5 million tons per year.

Finally Ahwaz Steel Complex, with direct reduction plant, steel making plant, long and flat rolling mills, wire drawing, seamless and water pipes plant, welding electrode making and so on. At the moment direct reduction plant produce 1.55 million tons per year.

In Isfahan Steel Complex which is under survey, some of the waste produced could be used in the same production line again with or without changes (2). Some others could be used in other workshops or departments inside the plant, the third group of waste could be sold. Finally the fourth group can not be used or sold because some of it is toxic and some have not got any known application yet (1,6).

## Materials and methods

In this research, in order to obtain the data regarding the wastes as, gaseous, liquid and solid wastes, the samplings were based upon searching and obtaining and then calculating through the monitoring manufactured instruments, which were recently installed at the processes and output channels. The monitoring and sampling manufacturers automatically show the output wastes while, the data are adjusted with the international standards. However, the environmental management searching for coordinating the national standards and criteria. Finally, the other data come through daily sampling and monitoring which report continuously for industrial wastes.

## Results

The results are shown as tables and figures at the end of the article. Table 11 demonstrates the wastes produced in different main departments according to their place of usage or disposal.

Figure 1 shows the amount of waste produced each year and its classification. As it is obvious, from 2,265,147 tons of wastes produced annually about one third (772,772 tons) could not be used or sold at the moment, and about %0.6 (4,225 tons) is toxic requiring special attention (5).

Figure 2 shows the waste classification according to its physical status. Tables 2 and 3 explain how the industrial wastes and by - products are processed, utilized and disposed in Isfahan Steel Plant. The most important ways are as follows:

1. Use of blast furnace slag, in a slag wool factory built especially for this purpose close to the steel plant. This factory produced 1,200 tons per year of slag wool, rolls and sheets, mainly used as thermal or noise insulator inside the parent plant or throughout the country. Annual production will increase to 12,000 tons in the near future. Blast furnace slag is also used in cement factories. Two of them located in the same area. The construction industry is another client of this slag, although it is going to be expensive for them these days.
2. Tar distillation plant; for more than 20 years crude coal tar has been in lagoons or exported, but now it is used in a pilot tar distillation plant inside the complex and very soon will be sent to a modern tar distillation plant being built for this purpose, close to the companies.

3. Slage of blast furnaces and sintering plant are used as raw material in iron ore pile of sintering plant. Now convertor scrubber slag is also considered to be used in the same way.

4. All the iron and steel waste and scrap is used in L.D. convertors.

5. Ammonium sulphate which is a well known fertilizer is produced from H<sub>2</sub>S of coking plant, after burning to SO<sub>2</sub> and making sulphuric acid and then combining with ammonia in the same plant.

6. The wastewater coming out after treatment of industrial wastewater and domestic sewage are used for agriculture and green spaces, inside, around and near the complex, while the necessary standards in this respect are met. The region has a dry and warm climate with a low rain fall. 2,000,000 trees have been planted, creating 5,000 acres of green landscape around and inside the site, in order to absorb some gaseous pollutants along with creating a moderate climate (Figure 3).

#### Discussion

From the ecological and economical points of view, obviously every attempt should be made to recycle or reuse the industrial wastes and by products. According to this policy the following measures have been tried in Isfahan Steel Plant and more are on the way:

1. Blast furnaces slag is used as a raw material in the slagwool plant and cement industries,
2. Crude coal tar is going to be used in the newly built tar distillation plant,
3. Most of the sludge and dust collected from different departments of the plant are transferred to the raw material yard of the sintering plant for usage,
4. Gases generated from blast furnaces and coke ovens are suitable sources of energy used in different furnaces of the factory,
5. Scrap metals and steel scales are used in convertors, sintering plant pig iron casting,
6. Wastewater of industrial and domestic sewage is used for agriculture and green spaces after treating and observing the relevant standards.

Finally, it is recommended the convertor and electric ore furnace sludge are deposited in the industrial area, creating ecological problems, a suitable solution for this problem should be sought.

Table 1- Wastes classification of Isfahan Steel Plant according to their site of production and usage

Department	On site use (T/Y)	Other dept. use (T/Y)	Sale to outside (T/Y)	No. use (T/Y)	Total annual production (T/Y)
Rolling mill	3,277	87,973	92,308.5	5.9	183,564.4
Refractory producing plant	160,700	21,664	27,883.8	8.50	211,097.8
Sintering plant	20,212	155	42,909	16,280	79,556
Steelmaking plant	121,635	43,020	519,845	498,600	715,239.5
Blast furnaces	-	183,065	580,859	210,510	974,429
Rep. and Mai. workshops	4,000	8,123.4	105.7	1,115	13,344.1
Coking plant	360	26,310	56,855	4,211	87,736

Table 2- Usage of wastes and by-products of Isfahan Steel Plant

No.	Kind	Usage	Under study	Quantity
1	Blast furnaces slag	slag wool plant, cement plants		665,000 T/Y
2	Blast furnaces dust	construction works	ZnO Quantity	15,200 T/Y
3	Blast furnaces slag	sintering plant	ZnO Quantity	all produced
4	Blast furnaces gas	sintering plant		420,000 m <sup>3</sup> /h
5	Coal tar	preheating of air for blast-furnaces burning in rolling, mill furnaces		52,000 T/Y
6	Coking plant controlled gas	export, tar distillation plants	use in blast furnaces or direct reduction plants	2,042 m <sup>3</sup> /h
7	Coking plant uncontrolled and discharged gas	refractory producing plant	use in blast furnaces or direct reduction plants	110 T/Y
8	H <sub>2</sub> S and NH <sub>3</sub>	burning in rolling mill furnaces	storage, no use found to date	49,000 T/Y
9	Steel making plant slag	process to ammonium sulphate fertilizer	use in sintering plant	35,500 T/Y
10	Steel making plant slag (convertors)			20,000 T/Y
11	Quick lime			21,000 m <sup>3</sup> /day
12	Sewage and industrial wastewater	agriculture and green spaces irrigation		all produced
13	Solvents, by-products of coking plant, benzene, xylene solvent	construction works extracted and sold		

Table 3- Wastes and their usage in Isfahan Steel Plant

No.	Wastes	Usage
1	Blast furnaces slag	Slag wool cement plants
2	Crude coal tar	Tar distillation plant
3	Dust and sludges	Sintering plant
4	Wastewater (Ind. & Dom.) treated	Agriculture and green spaces
5	Chemical by-products	Fertilizer and solvent recovery
6	Scrap metals	Convertors
7	Convertors slag	Deposite

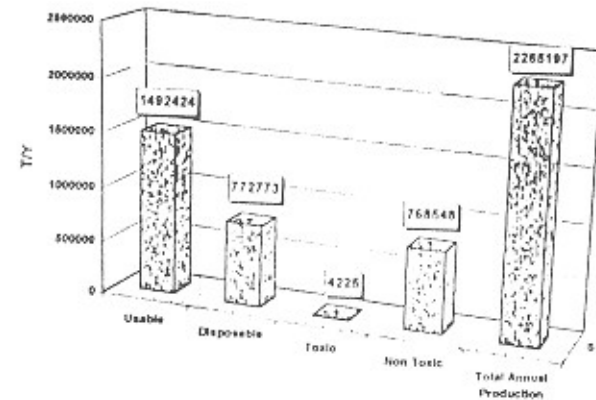


Fig. 1- Waste Classification of Isfahan Steel Plant According to Its Usage/Disposal

physical status	solid	semisolid	liquid
amount (T/Y)	104,422.9	64,349	4,210

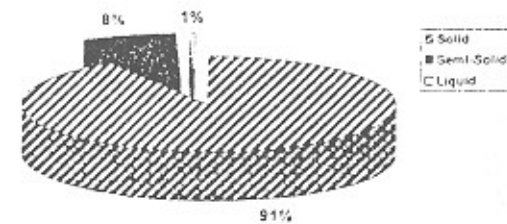


Fig. 2- Disposable Waste Classification of Isfahan Steel Plant according to their Physical Status

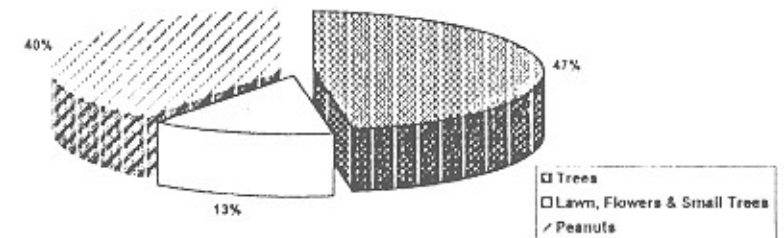


Fig. 3- Isfahan Steel Plant Green Landscape

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