Ain Shams University

Institute of Environmental studies and Research

Environmental Engineering Department

Suggested Alternatives for the Cleaner Technology of Casting Industry

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This thesis is submitted as a partial fulfillment of the requirements for the degree of Master of Science in Environmental Engineering

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Abstract

Casting process is one of the most important methods used in producing metallic products, which can be selected from four main production methods; casting, cutting (machining), assembling and joining by rivets , bolts or welding and forming as the forth method .

Casting method of production is affected by many different factors during production operation, resulting in one of two options at the end of this operation; accepting the casted product as first option or rejecting it as a second option.

The problem in selecting casting process as a method of production, is the great environmental loss due to repeated casting of the same rejected product, because of the various kinds and different quantities of polluting emissions produced at the different steps of casting process, beside the emissions from burning the fossil fuel used in melting the quantity of metal needed for this product.

When putting reduction or minimizing the pollution resulting from casting operation as principal target , the research will follow tow important directions ; the first one is the best planning for the casting process to guarantee the optimistic method for casting operation and also ensure minimum material and power consumption at minimum time of production . The second direction is the following of the up to date methods of quality control, to ensure the best accepted casted product from the first melting process.

In going to reduction of materials and controlling the quality of materials, machines and products, the research will not neglect the effect of computer aid and the quality of human beings dealing with casting technology, taking in consideration that best product is closely related to skill and good trained labour , supervisor and highly qualified manager .

Avoiding all negative factors of casting industry in connection to the environment and supporting all positive ones , casting industry can be considered as the best method for reusing of great quantities of metallic scrap all over the world and not a dangerous cause of environmental pollution .

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List of Abbreviations & Nomenclature

DBC	Divided Blast Cupola
CI	Cast Iron
TQC	Total Quality Control
ANSI	American National Standard Institute
ISO	International Standard Organization.
QC	Quality Control
BSI	British Standard Institution
ASTM	American Society for Testing material.
IPC	Integral Pollution Control
LAPC	Local Air Pollution Control
VOC	Volatile Organic Compounds
3 Media	Environment 3 Mediums (Air, Water and Land)
3D	Three Dimensions
SPH	Smoothed Particle Hydrodynamics
SPM	Suspended Particulate Materials
PH	Indication for the degree of acidity
PSC	Process Sensing Control
CFD	Computational Fluid Dynamics

Chapter 1

Introduction, Problem ,Target and Procedure

1.1 Introduction:

Casting industry is the second technology in the USA after electronic industry. It gains its importance from that 80% of the metallic spare parts in different machines are born for the first time in the foundry, then different machining processes, if required, are done to get the end product.

In Egypt, same as USA, casting process is also an important industry in spite of the conventional traditional technologies adopted in medium, small and large foundries, which use different kinds of furnaces and different processes for production, where some of them agree and have friendly effect on the environment, and most of them do not agree and have a very bad effect on the environment.

Casting process technique is defined as a way for producing products through the following steps:

1. Melting the metal by raising its temperature to the melting point using different kinds of furnaces, then to exceed the melting point by about 100˚C to sustain and keep the metal in its liquid state till reaching the mold.
2. At the same time and parallel to the above step, a mould with a cavity taking the shape of the wanted product is prepared. The kind of the mould differs according to the kind of casting process and also according to the shape of the product.
3. Transmitting the molten metal in a ladle from the furnace to the mould.
4. Pouring the liquid metal in the prepared mould. The molten metal will penetrate through the cavity filling the space and rejecting the air, thus taking the shape of this cavity.
5. Waiting the molten metal to solidify.
6. Trimming and getting rid of the excess parts (Sprue, riser, flashes), then finishing the product.

For this process to be achieved, the foundry must be planned to include the following:

1. Scrap yard to prepare the correct charge for the furnace.
2. Furnaces yard where the metal is melted.
3. Moulding yard to prepare the mould (Sand mould, die mould, investment mould, …)
4. Means for transporting the molten metal from the furnace yard to the mould yard, then pouring it in the prepared mould.
5. Means to extract the product from the mold.
6. Compressed air and sand blast to clean the semi finished product coming from the mold.
7. Machines department, containing metal cutting machines and carpentry machines, for maintaining foundry equipments and making wood patterns.
8. Testing of material and quality control department for analyzing the charge constitution, before entering the furnace and analyzing molten metal elements after leaving the furnace, and checking the products to be sure that they are free from defects.

1.2 The problem

Casting process is an important production process for the industrial sector, In spite of its shining side, it has a bad side represented by its effect on the environment resulting from the hazardous effect of emitted gases (Carbon oxides, sulfur oxides, Nitrogen oxides, and other heavy metal oxides) on the human beings living in this environment. In addition to the amount of heat emitted from the surface of the molten metal added to the heat and gases emitted from burned fossil fuel used in melting this metal. It is also important to take into consideration the slag & ashes lift from the face of the molten

metal and its impact effect on the environment when getting rid of it in the earth

1.3 Target

Since the casting process has many positive sides related to the development of the industry of any country, and being one of the most practical method for recycling metallic scrap, it has also many negative sides represented in its severe pollution of the environment (both indoor and out door).

This research will deal directly with how to increase the positive effects of the casting process, and in the same time decreasing its negative effects on the environment.

1.4 Procedure

The research followed two directions to achieve the research objectives:

First Direction: Theoretical study which includes:

- Illustration of the three fundamental industrial metals used in foundries: Copper, Steel and Aluminum; its sources, its methods of extraction, their properties, and their industrial use.
- Illustration of the different activities and different types of casting processes for choosing the best preferable one relative to a certain product.
- Planning for optimizing the casting process.
- Illustration of modern systems for casting quality control.
- Adoption of environmental planning and quality control.

Second direction: Practical study which includes:

- Mathematical calculations, supporting the positive action of the casting process on the environment.