SAND CASTING – A BASIC REVIEW

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Abstract- **DISAMATIC is an automatic production line used for fast manufacturing of flaskless sand moulds for green sand casting. This process is commonly used to mass manufacture of metal castings for the automotive and machine industrySand castings process is vulnerable to many defects resulting in high rejection rates. A foundry that produces within 5% rejection is considered to be normal while the quality today is expected to conform part per million defects. Hence control of defects has become an important issue for the foundry industrySand castings process is vulnerable to many defects resulting in high rejection rates. A foundry that produces within 5% rejection is considered to be normal while the quality today is expected to conform part per million defects. Hence control of defects has become an important issue for the foundry industry The purpose of this paper is to optimize the sand casting process parameters of the castings manufactured in iron foundry by maximizing the signal to noise ratios and minimizing the noise factors using Taguchi method. Models for moulding sand characteristics have been proposed using multiple linear regression analysis and ANN and a comparison is made between regression models and ANN models. The process parameters considered are moisture, sand particle size, green compression strength, mould hardness, permeability, pouring temperature, pouring time and pressure test.**

Index Terms- **Casting defects; Control factors; Sand casting Fuzzy Systems, Knowledge Based Systems.**

I. INTRODUCTION

Designers are responsible for the per-formance of their designs. Traditionally, designers have used simple shapes and homogeneous material properties to determine the adequacy of their designs. A factor of safety is usually incorpo-rated into a design to compensate for uncertainties caused by a complicated part shape, unknown service or loadDesigning castings is difficult. Casting complex shapes is limited by solidifica-tion behaviors that can result in unde-sirable features that may affect perfor-mance. In terms of component design, casting offers the greatest amount of flexibility of any metal forming process. The casting process is ideal because it permits the formation of streamlined, intricate, integral parts, of strength parts and rigidity obtainable by no other method of operations. The shape and size of the part are primary considerations in design, and in this category, the possibilities of metal castings are unsurpassed.These factors of safety have resulted in reliable performance and, when adjusted or "tuned" based on performance testing, they have become the standard approach for most designs. Casting is a process which carries risk of failure occurrence during all the process of accomplishment of the finished product. Hence necessary action should be taken while manufacturing of cast product so that defect free parts are obtained.

. Many designs are incremental, based on analogous parts in prior designs. In high-volume transportation applications, such as in the automotive industry, durability and warranty experience allow designs to be customized to give optimal per-formance. Casting is a process which carries risk of failure occurrence during all the process of accomplishment of the finished product. Hence necessary action should be taken while manufacturing of cast product so that defect free parts are obtained.Vertically parted automatic flaskless casting process consists of a molding machine and mold transporting conveyor. It applies clay bonded sand mixtures, also called green molding sands due to its moisture content. Such mixtures consist of silica sand, clay called bentonite and few other additives. Metal casting is the most versatile primary manufacturing process. It has ability to produce complex products from few grams to several tons in any material that can be melted.. Sand castings are produced in specialized factories called foundries. Over 70% of all metal castings are produced via a green sand casting process. Although there are many new advanced technologies for metal casting, green sand casting remains one of the most widely used casting processes today due to the low cost of raw materials, a wide variety of castings with respect to

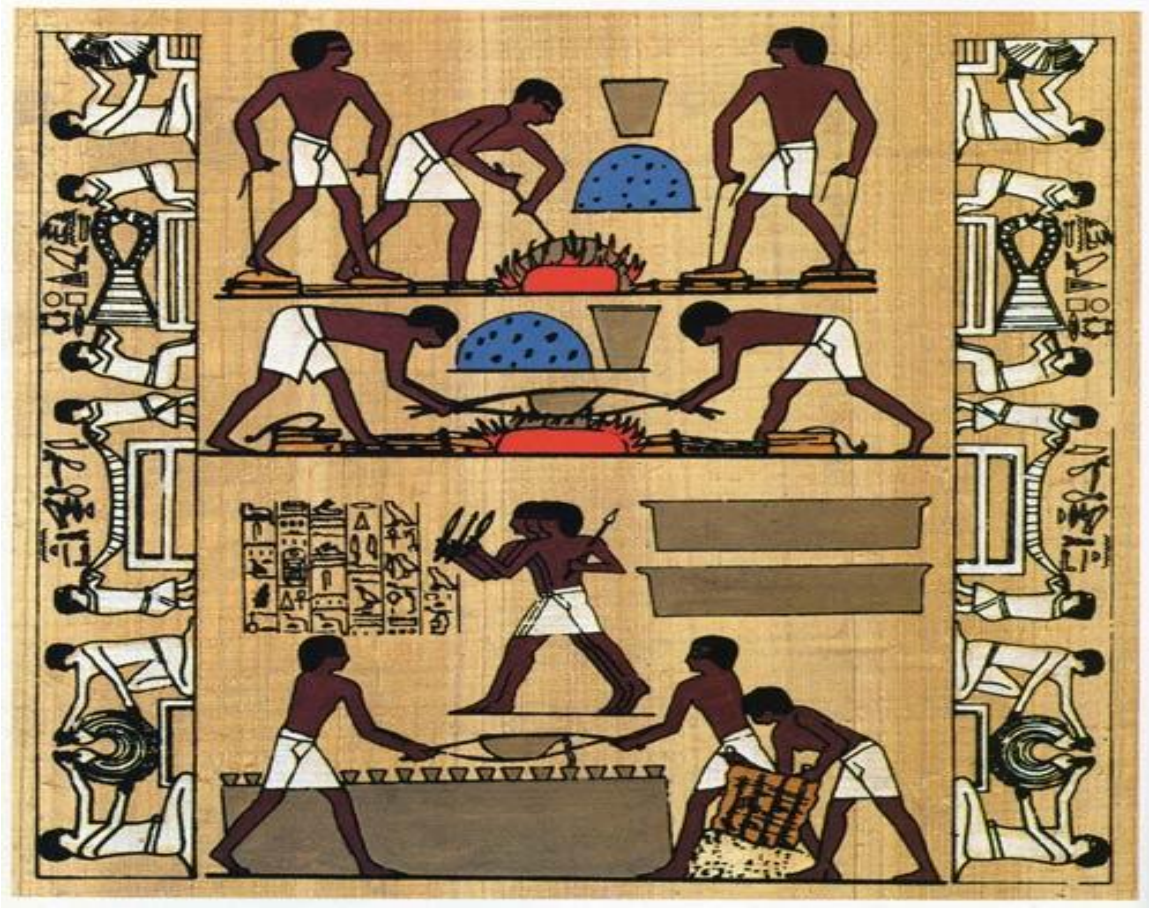
size and composition, and the possibility of recycling the molding sand

II. REVIEW

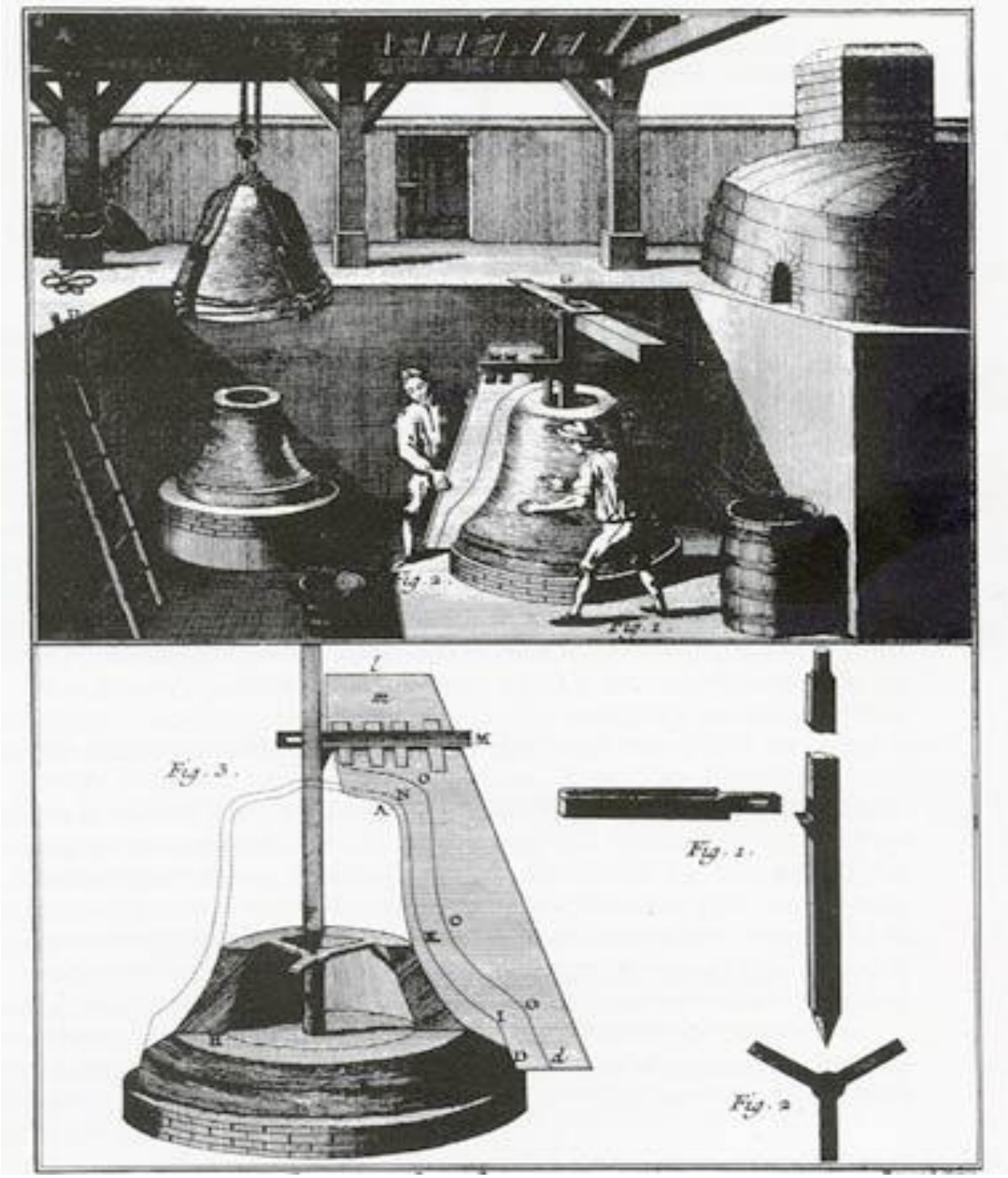
Sand casting is one of the most common production technique used for manufacturing ferrous castings. Cupolas are solely used by iron foundries for continuous production of molten iron. Der Ho Wu et al [9] applied the Taguchi method to optimize the process parameters for the die casting of thin-walled magnesium alloy parts in computer, communications and consumer electronics industries. The results confirmed the effectiveness of robust design methodology.

Early History:

- **The oldest known cast in existence is a copper frog from 3200 BCE in Mesopotamia**
- Other early casts from around 3000BCE like weapons and cult objects were discovered in the Middle East and India.



- The earliest known sand mold came from China in 645 BCE
- In 233 BCE, cast iron plows were cast in China.
- In the year 500, cast crucible steel was first produced in India.
- This process was lost until 1750 when an Englishman named Benjamin Huntsman rediscovered it.



Advancements in Sand Casting

- **In 1924, the Ford automobile company set a record production of 1 million cars, consuming the casting industry.**
- **Experiments were conducted with types of clay to improve strength in molding sand, updating cupola furnaces to electric and moving the traditional foundry to a factory setting improved process.**
- **Now, sand casting is a fully automated factory system.**

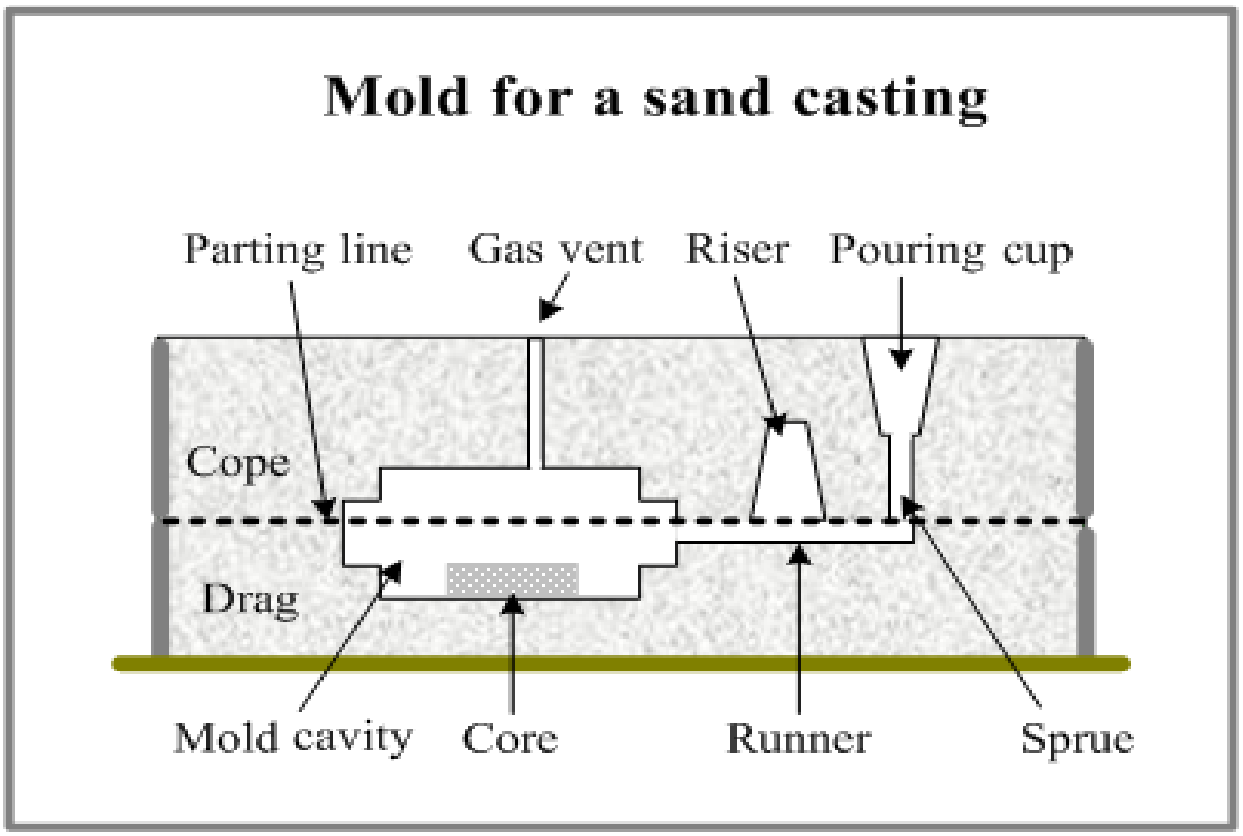
About sand casting

- **Sand Casting is a process in which a cast is formed from a molten metal in a sand mold.**

- **Can be used to produce a range of sizes from a fraction of an ounce to hundreds of tons.**

General Sand Casting

- **Two-piece casting flask**
  - **top is cope, bottom is drag**
- **Sand packed around pattern of intended shape**
- **Gating system for metal flow and escape**
- **trimming necessary**
- **Often used with automotive parts and piping**
- **Iron, steel, bronze, aluminum, lead, tin, zinc**



Types of Sand

- **Green sand most common**
  Silica sand, water, clay

Named for moisture, not color

- **Sand must maintain certain properties**

i.e. strength, thermal stability, collapsibility, reusability

- **Compressed with hydraulic pressure**
- **Sometimes different layers of different qualities**

Traditional Preparation

1. **Heated oven to 900°F to melt the Zinc.**
2. **Made pattern of acorn out of wax.**

3.Used tin cans as frame for the mold.

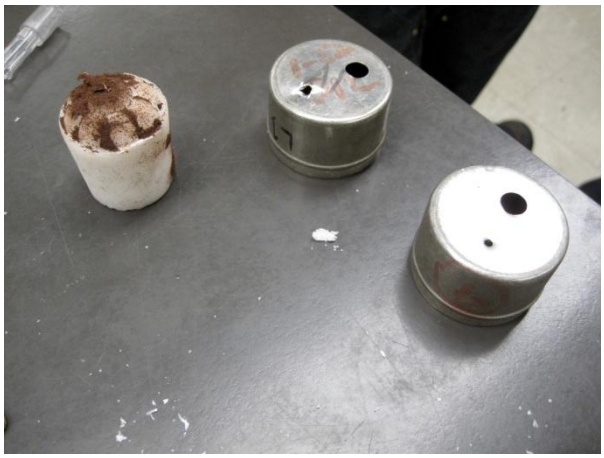
4 **Carefully separated two halves with a knife.**

5 **Made pouring spout and**

6chimney in the mold. Reattached two halves of the mold

Traditional Casting

- **Poured molten Zinc and let sit.**
- **Cleaned up edges with file**
- **Cast acorn then removed and set to cool.**
- **Cast was very close to the original pattern.**

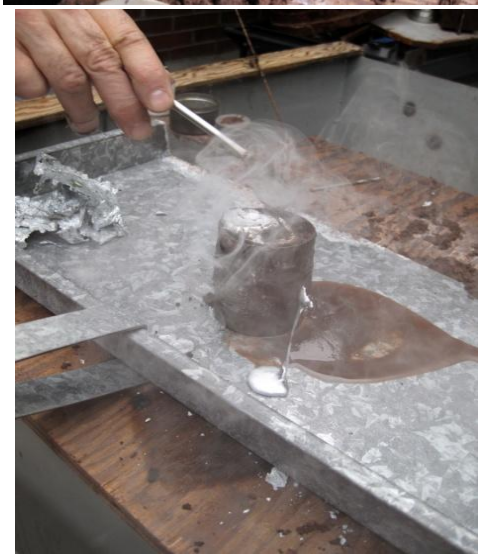


Lost Wax Preparation

1 Extra Zinc is heated to melt
2 Same steps to create mold
3 Wax pattern left in mold

Lost Wax Casting

1. **Poured molten Zinc into mold**
2. **Wax started to melt out**
3. **Zinc cooled prematurely, trapping wax**
4. **Zinc cooled prematurely, trapping wax**



Advantages

- **Capable of large size**
- **Capable of holding details**
- **Useful for metal with low ductility**
- **Most economical type of fabrication**
- **Minimal waste**

Disadvantages

- **Empty space can be weaken metal**
- **Poor surface metal**
- **Small parts hard to remove**
- **Additional hardening usally needed**

III. CONCLUSION

The knowledge acquired from domain experts, is coded in the system. This can help foundry engineer to know in advance the outcome of the input process conditions. The improvement expected in minimizing the variation is 37.66 percent which means reduction of casting defects from present 6.16 percent to 3.84 percent of the total castings produced in the foundry. This also reflects that by using Taguchi method the factor levels when optimized will result in reduction of casting defects and increase the yield percentage of the accepted castings without any additional investments. . The on-line application using

internet enhances the scope and also helps in making the expertise knowledge of defects and their causes to novice engineers Mathematical models developed for the estimation of compatibility, green compressive strength, spalling strength and permeability may be a very useful tool for predicting these molding properties on the shop floor.

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