

Casting defects analysis by the Pareto method

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Abstract

On the basis of receive results formed of diagram Pareto Lorenz. On the basis of receive graph it affirmed, that for 70% general number casting defects answered 3 defects (9 contribution – 100% defects). For 70% general number defects of influence it has three type of causes: sand holes, porosity and slag inclusions. The defects show that it is necessary to take up construction gating system. The remaining 8 causes have been concerned only 25%, with general number of casting defects. Analysis of receive results permit to determine of direction of correct actions in order to eliminate or to limit the most defects.

Keywords: Casting defect, Pareto analysis, Porosity, Slag inclusions, Sand holes

1. Introduction

Pareto – Lorenz diagram enables ordering and easy to understand analysis of gathered digital dates. The system of gathering the dates and its reliability decide about the system usefulness. When the analysis concerns complicated group of factors it is advisable to make one more analysis [1]. The aim of this action was to find out the factors which had an influence on the numbers of defectives or its costs. The diagram is ordered for sake of validity of the factors. It can also show if a quality improvement program was effective. The method reveals the problems which solution can give the largest profit. It proves also, which actions do not bring significant profits.

2. Analysis of casting defects

The index of per cent of faulty castings (for test period 12 months) was oscillated in range from 5,2% to 14,8%.

The some defects of most cases of produced castings frequently has been appeared, table 1. For example the per cent participat of assortment were concerned: sand holes over 90%, slag inclusion about 58%, shrinkage 52%, misruns 42% and porosity 39 %.

On the basis of received results it has been formed a Pareto Lorenz diagram (fig. 1). Cumulated values have been located on vertical axis, while on horizontal axis - casting defects in per cent scale. On the basis of received graph it has been affirmed, that 75% general number of casting defects it compose three type of defect: porosity, slag inclusions, sand holes. The three defects indicate that it is necessary to modify construction gating system. The remaining 6 types of defects have composed only 25% of faulty casting. Analysis of received results permits to determine the direction of correct actions in order to eliminate or to limit 3 the most popular defects. Quality control on a stage of projecting the manufacturing process is connected with design of a product. The projecting of manufacturing process consists selection of engineering process, auxiliaries process and quality control, beginning from material properties through interoperation control to acceptance the inspection of final products [2, 3]. The selection

of engineering process, essential machines, installation, apparatus and tools and special instrumentation consist of the process of projecting of manufactures process.

For technology operation it has been defined the essential equipment, instrumentation, tools and technological parameters.

Such a proceeding taking into consideration workmanship already during projecting of manufactures process, can be defined as projecting resistant to perturbation actions [4, 5]. During projecting of manufacture process, an enterprise should plan and work out the process necessary for realization of the product.

The planning and product realization should be coherent with the requirements concerning other process of quality management system. Planning the product realization, the enterprise should define:

- aims concerning the quality and requirements concerning the product,
- need concerning making the process, documents, as well as providing the resources specific for product,
- the required actions concerning verification, validation, monitoring control and tests,
- the recording necessary for provision of evidences corroborating that realization process and product meet the requirements of quality.

Table 1.
Per cent participation of defects on the total faulty castings

Type of casting defect	% assortment participate in	% participation defects	% growth
sand holes	92	27	27
misrun	42	20,6	47,6
shrinkage	52	18,6	66,2
Porosity	39	14,3	80,5
slag inclusion	58,9	5,3	85,8
sand buckle	22	3,9	89,7
blowhole	10,1	3,1	92,8
swell of the mould	27,8	2,7	95,5
mould shift	26,7	2,4	97,9
hard spots	10,4	2,1	100,0

The enterprise should manage the connections among various groups which participation in the planning and development in order to assure the effective communication and clear determination of responsibility.

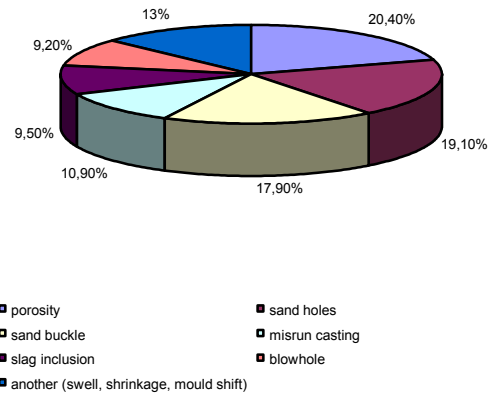


Fig. 1. Participation of per cent of casting defects on the general defects

Inadequate cross sections elements of gating system channels can be of the cause of castings misrun.

The blowhole is the void in the cast with the spheroid or oval form.

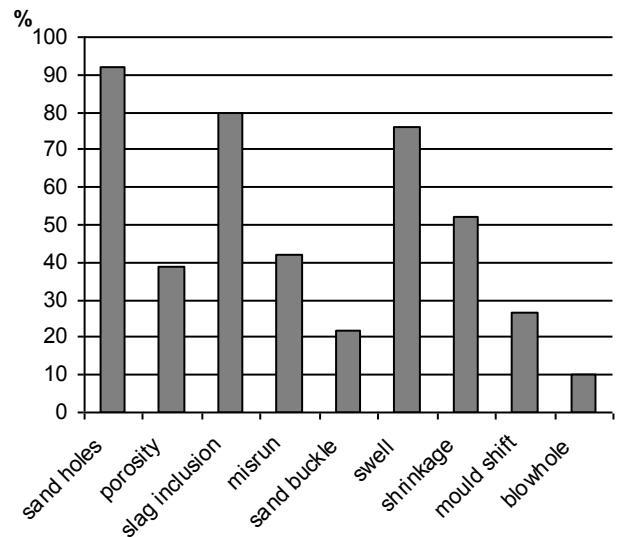


Fig. 2. Participation of per cent of casting defects in the productive assortment

Sand holes can arise as result of defective pattern made and set of gate patterns, fig. 3.

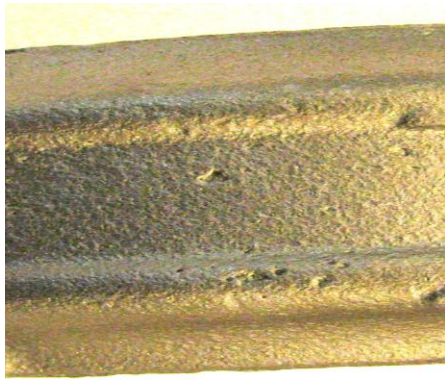


Fig. 3. Sand holes of casting

Essential influence on the arisen of sand holes have a quality of moulding sand.

In order to decrease of sand holes quantity in castings it is necessary to apply of moulding sand with green strength.

The local cluster of small voids is defined as porosity, fig. 4. This defect arises frequently as a result of gas separate from a solidification metal.



Fig. 4. Porosity of casting

The porosity can arise also as a result of gas separate from a moulding sand. The mechanism of porosity formation is analogous to the blistering, because the causes of formation these defects are identical.

The most frequently cause of blowholes formation is gas separating from a moulding sand, rarely gas separating from solidify metal, fig. 5.

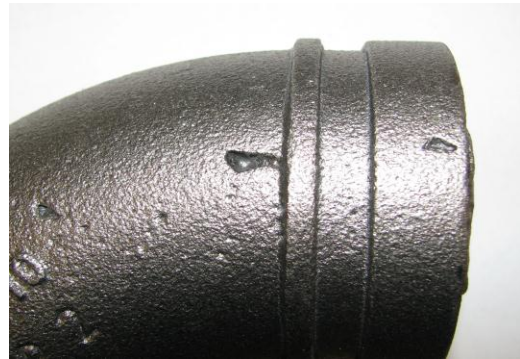


Fig. 5. Blowhole of casting

The sand buckle is a build up which arise on the casting surface as a result of liquid metal penetration to the surface of sand mould.

The small sand strength, high temperature liquid metal and long time of pouring are the factors conductive to the sand buckle formation. Moreover, long time of pouring causes that superheated liquid metal strongly heats the top surface of cavity niche.

The shrinkage is defined as shallow and extensive hollow with smooth surface and oval outline, fig. 6.



Fig. 6. Shrinkage porosity of casting

The shrinkage can arise only in place, which is not or is wrongly feeding by liquid metal. The wrongly feeding through riser can often cause formation of shrinkage in castings. The reason of shrinkages can be also wrong project of gating system or hot moulding sand [3].

The mould shift is defined as part casting displacement with respect to oneself in parting plane of sand mould or core.

Mould shift can be also caused by the constructional defects or wrong assembly of sand mould to pouring or attrition of moulding box pins.

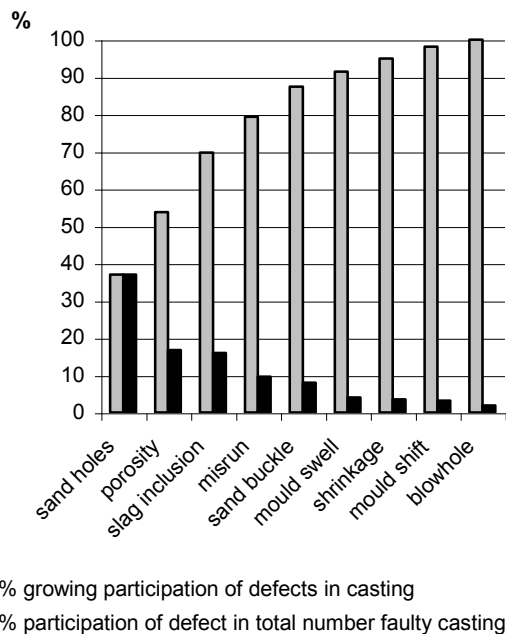


Fig. 7. Per cent participation of casting defects in total number faulty castings

The swell of the mould is distinct deformation of casting surface. The reason of swell of the mould can be the little compression strength of sand moulding wall with the metallostatic pressure.

The hard spots define of place in grey castings where there are a carbon in form of Fe_3C on the grey cast iron structure. The structure formation in cast iron state depends with chemical composition, solidification rate of casting in the mould.

3. Conclusions

The example which shows necessary of quality control already on a stage of planning of industry process can be the gating system. The analysis of causality of formation faults in castings was showed, that a few dozen per cent of casting faults can arise by reason of incorrect construction of gating system. The gating system is determined of channels pattern equipment which permits of pouring of moulds. In the process of created of gating system make possible: the filling of casting moulds of liquid metal on the required velocity, stoppage of achsentitious in parities and slag in flowing metal obtaining required, temperature distribution of metal in mould which pouring in this way, which enable directional solidification of casting. Inadequate of gating system construction can be of cause of various casting defects, for example: misrun casting, porosity, slag inclusion and shrinkage.

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