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Methods of porosity elimination from valve corps casting made of bronze

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Summary. Currently an increase is observed in quality requirements from manufactured products and installations. This also applies to castings. One of methods of improving cast quality is using modern porosity sealing methods during the technological process. This method has found wide use in the world in order to not only improve the working parameters of foundry operations, but also the quality of welding, sintering, electronics, artificial materials. There are industries where 100% of the produced cast is sealed. The article shows the method of leak-tightness improvement in valve castings working in extreme conditions e.g. extreme temperatures or adverse chemical environment.
Key words: leak-tightness, defects, castings repair, sealant.

INTRODUCTION

In iron, which is not made of non-ferrous metals and alloys, there are often defects such as foundry losses, gas bubbles, porosity, and others which in extreme cases lead to castings rejection.

This problem is especially significant during working in extreme conditions where, e.g., resistance is required to:
– increased pressure, e.g. 1, 6 MPa,
– temperature (increased or reduced),
– chemical reagents, sea water.

Since these defects often are detected after additional treatment operations such as removal, heat treatment, the costs incurred adversely affect the company budget, by increasing costs of its activities.

Therefore, technical staff of the companies are seeking to find methods of repairing of those equipment items. The application of repair casting is required to obtain proper technical economic and aesthetic properties [1, 2, 3, 6, 7, 8, 9].

REPAIR METHODS

Currently an increase is observed in quality requirements from manufactured products and installations, which also applies to castings. One way of improving cast quality is application of modern methods, such as sealing porosity repair, in the implemented technological process.

The above-mentioned method has found wide use in the world, not only to improve the working parameters of foundry operations, but also the quality of welding, sintering, electronics, artificial materials. There are industries where during the technological process 100% of the product is being sealed. Currently an increase is observed in quality requirements posed in practice, not only for iron. There are various methods of sealing repair in castings concerning faults caused by gas porosity, cracks in the cold and other defects affecting the cast's seal-tightness [10, 11, 12, 13, 14].

Health hazardous industrial elements of casts are under control, using several tests, in order to ensure the required foundry quality. Part of quality requirements are determined by the national standards and part of them by the European norms.

To meet all the requirements, the standards should be observed not only in quality of castings, quality of the hazardous connective elements, leak-tightness and productivity, but also in a number of other aspects [4, 5, 15, 16, 17, 18, 19].

The research was factory-based (S.A. is a leading producer in the industrial fittings export).

In the experiments (for a certain group produced castings were made of copper alloys with the technical conditions reception), the required technical leak-tightness was sought.

Tests were carried out on sample castings to show leak-tightness of a certain percentage of castings, due to lack of porosity defects occurrence.

The world's leading solutions that have been adopted in the casts production involve the method which is required for tightness of castings, where the process of production is solved so that the technological process in the cycle of castings is amended in order to apply sealing-repair process in 100% castings.

Tightness test is carried out after the carried out repair on the randomly selected casts. The sealing method involves the

introduction deep into the casting wall of synthetic sealants which have been effective so far in the sealing of all the leeks in a casting and providing its seal-tightness required by the technical conditions of acceptance.

For the repair different sealants are used, prepared on the basis f epoxy resins, polyurethane, polyester, anaerobic [20, 21, 22, 23, 24].

The sealant may be forced deep into the casting wall in a mechanical, manual or enforced (increased pressure, vacuum) way.

There are many producers of sealants and devices for sealing.

Their parameters are different from the sustainability of the sealing, within the scope resistance to chemical agents, increased or reduced temperature, the type of chemical composition preparation way, parameters of application, the range of temperatures.

Some manufacturers shall ensure the system of automatic control of the sealing process.

The sealing process as well as the applied substances should be safe for the worker and the environment.

In foundries which have not undergone the above-described process (Figure1) there are leak defects caused by the presence of transverse porosity sections in wall casting. Repair of a cast working in increased pressure conditions is effective when gas pores sizes are small.

Together with an increase in pore size, bubbles and gas pressure are spoiling the effectiveness of castings repair by impregnation method.

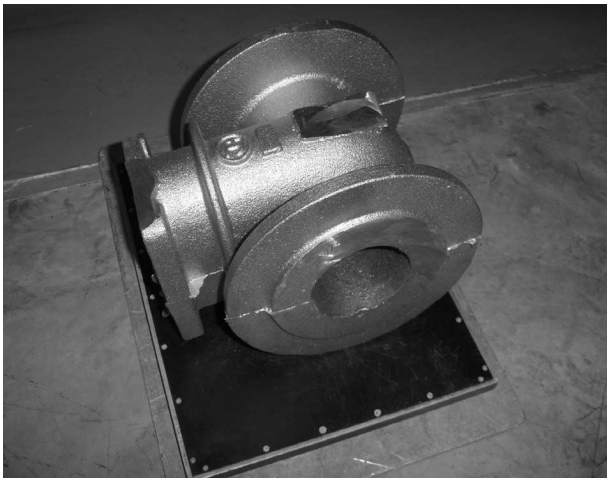

Fig. 1. Cast of corps DN 150 during preparation for an X-ray

In practice, not only for iron, there are various methods of sealing repair, in case of porosity presence caused by gas, cracks in the cold and under high pressure or other defects of castings affecting their seal-tightness.

The basic methods of repair can be:

– mechanical; (e.g. welding, reaming, high etc.). These methods do not ensure seal-tightness of casting affected by the presence porosity. They are applicable in articles where seal- tightness of casting is not required .
– chemical; (impregnation, diffusion, adsorption, application, immersion, necessitated by the sealants leaks in the area). These are methods recommended for the repair of leak defects in castings. These methods of casting repair are the so-called surface (wearing, immersion) ones, which do not fully ensure the required tightness of casting, the sealant does not fully get to the internal parts, on the surface of casting there is an additional layer cover which may not be accepted by the casting manufacturer.
– replenishment of losses, (for large losses). Used for the repair of large losses, especially occurring on surfaces of casting. Used for the commercial and aesthetic reasons. This method is not recommended for sealing of porosity castings requiring the determined parameters of seal-tightness [25, 26].

Choice of the repair method is dependent on technical requirements and economic considerations.

LEAK TEST OF CASTINGS

Factory “JAFAR” is a constructor, the producer of castings and valves which work in extreme conditions. Elements of valves are made of iron, bronze, brass. These are the water valves, gas, air, or valves on chemical agents. They work in the conditions of increased pressure, temperature or chemically active environment. The conditions of their technical reception statement indicate that they may not have defects involving external or internal leakage which eliminate devices part of which is formed by a cast. When developing new construction of valves, research activities were carried out related to development of assumptions of the technical and technological research using the methods of computer simulation. Acknowledgement of the adopted assumptions is their technical check in the current conditions. In drawing up of the technical assumptions, technological experiments on DN 80 valves and DN 150 computer simulations process were carried out on liquid metal movement in the form of seats which were at risk at porosity defects (Figure 2, 3) [27].

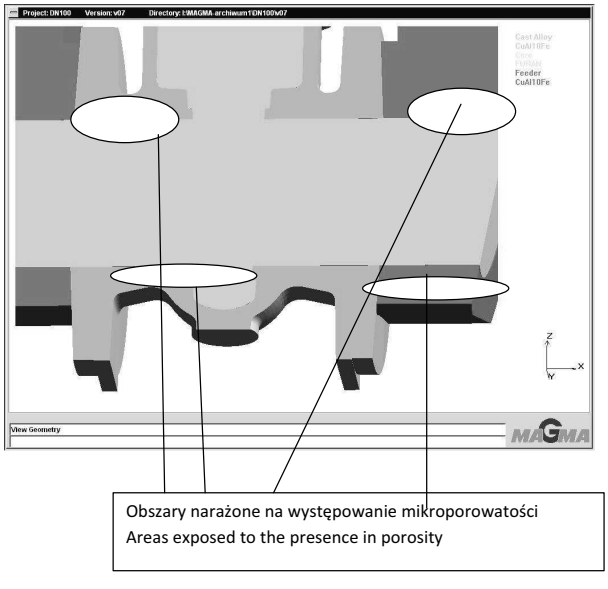

Fig. 2. Areas of porosity in the cast of valve corps

Areas in which the withdrawal is planned of foundry defects, gaseous bubbles, leaks, are characterized with areas of a variable thickness.

We have developed a number of solutions for technical and technological methods of castings repair. The chemical composition of sealants and construction of equipment used to process the sealing is the restricted information on the part of manufacturer.

After computer simulation and analysis, the carried out valve corps casts were tested in the candling position x (Figure 4) and the position to test leak of casting (Figure 5).

The obtained results were used to make a decision for the repair of defective cast by the method of sealing. (Figure 6). One of the principal technical solutions which are currently used in many countries for sealing castings was applied to the equipment, usually consisting of several tanks in which there are:

– process of preparing,
– forcing the sealants deep into the casting wall (high pressure, vacuum),
– chemical, thermal hardening
– washing
– cooling and removing cast from tank,
– technical inspection.

CONCLUSIONS

Sealing devices and technologies have many advantages but they also have defects.

The scope of these devices for the repair of casts is limited by their dimensions, quantity of produced castings (size series), diverse shapes and dimensions and the nature and characteristics plastic castings sealants, including:

– mechanical and thermal strength,
– resistance to chemical reagents' impact,
– ability to penetrate deep into the casting wall,
– resistance to the leaking of casting,
– bonding (reinforce) sealants,
– the ability and the way of the removal of external surface sealants from castings.

In the last period the knowledge has increased of the pros of the sealing process, its quality (pros and cons) and the opportunities for the application of sealants. The sealing process is now a tool to improve the quality of the manufactured products.

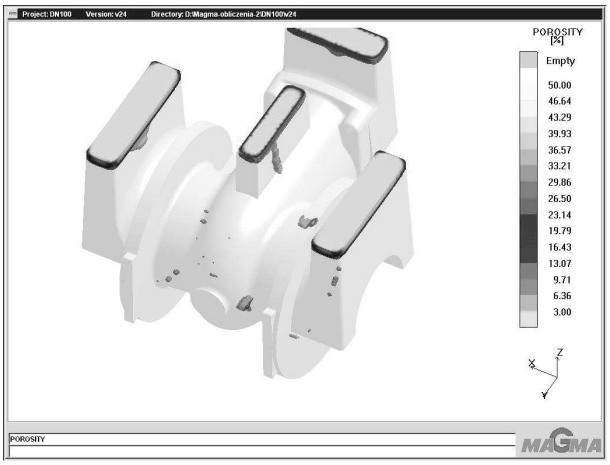

Fig. 3. The predicted sites of porosity in the valve corps cast DN 80

Fig. 5. Test of seal-tightness of the valve (in water)

Fig. 4. Corps cast DN 150 in the X-ray stand

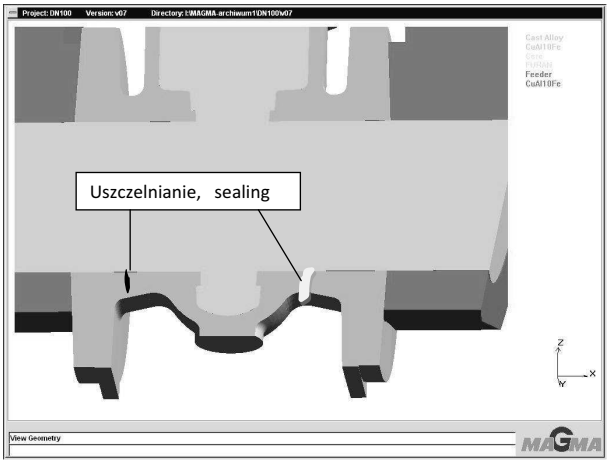

Fig. 6. Introduction of sealants deep into the wall of valve corps cast

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METODY ELIMINACJI POROWATOŚCI ODLEWU KORPUSU ZAWORU WYKONANEGO Z BRĄZU

Streszczenie. Aktualnie obserwuje się tak w kraju i za granicą wzrost wymagań jakościowych stawianym wytwarzanym produktom, urządzeniom. Dotyczy to również odlewów. Jedną z metod poprawy jakości odlewów jest wprowadzanie do procesu technologicznego ich wykonywania, nowoczesnych metod uszczelniania mikroporowatości. Metoda ta znalazła w świecie szerokie zastosowanie do poprawy własności, parametrów pracy nie tylko w odlewnictwie ale w miejscach spawanych, w elementach spiekanych, elektronice , mechanice, tworzywach sztucznych. Są gałęzie przemysłu gdzie 100% wyrobów, odlewów jest uszczelniane. W artykule przedstawiono metodę poprawy szczelności odlewów zaworów pracujących w ekstremalnych warunkach; temperatura, środowisko chemiczne.

Słowa kluczowe: szczelność, wady, naprawa odlewów, szczeliwo