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The elimination of porosity in castings which are subjected to pneumatic or hydraulic pressures has long been a problem in the die casting industry. Although good foundry practice can reduce porosity to a large extent, it is usually necessary in controlling leakage to impregnate the castings with a chemical sealing compound. Since this chemical method is both tedious and expensive, considerable research has been performed to discover other solutions to the problem.

One method that has been found successful in sealing off the porosity is by cold working the surface through shot peening. This process involves pelting the surface of the casting with round metallic shot at a relatively high velocity in specially equipped machines.

As an example, the author cites the case of a large manufacturer of die cast aluminum alloy hydraulic cylinder caps. On one type of casting, rejects due to leakage ran approximately 50%, and on a similar type of casting subjected to more rigid foundry control, rejects because of leakage were 16%. A table-type airless blasting machine, manufactured by American Wheelabrator and Equipment Company, was installed to peen these castings prior to machining. Leakage rejects dropped from 50% to 20% in one case, and from 16% to 4.5% in the other, and most of the leakage that did occur took place at machined surfaces where the effects of shot peening were removed.

The author states that it seems likely in cases where machining is not required, or where peening may be done after machining, the problem of leakage in castings can be eliminated almost completely by exercising careful control of the casting and shot peening operations.

(C. F. Horvat, abstractor)
To Reduce Porosity in Die Castings

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SHOT PEENING

A problem which has long confronted the die casting industry is the elimination of porosity in castings which are subjected to pneumatic or hydraulic pressures. The frequency with which this condition occurs can be reduced to a large extent by careful control in the foundry. However, in many cases, despite the most painstaking care in foundry technique, a certain amount of porosity persists.

Many chemical methods have been developed for eliminating leakage in porous castings by impregnating the castings with a setting compound. Although usually effective in eliminating leakage, these processes are almost without exception, both tedious and expensive.

Considerable research has been performed in an effort to discover new methods of processing die castings which would eliminate, or at least reduce, the necessity of chemically impregnating castings. One process which has been tried and which has met with a considerable amount of success is shot peening.

Shot peening is a cold working process accomplished by pelting the surface of a metal part with round metallic shot thrown at a relatively high velocity. The process is done in specially equipped machines similar to those used for blast cleaning.

One large manufacturer was confronted with an aggravated case of leakage in the cast aluminum alloy hydraulic cylinder caps. His testing procedure called for spot checking each batch of castings in a special device forcing air at 35 psi into the casting immersed in a water bath.

The formation of bubbles indicated leakage, and if a high percentage of leakage was found in any particular batch of castings, every unit in that batch was tested in this manner before being assembled.

After final assembly of the finished product, every unit was hydraulically tested at pressures varying from 50 to 2100 psi.

On one type of casting, rejects due to leakage ran approximately 50% in the "as cast" condition. On a similar type of casting subjected to more rigid foundry control, rejects because of leakage in the "as cast" condition were approximately 15%.

In one of a number of attempts to alleviate this condition, the manufacturer tried shot peening the castings before testing. This proved so satisfactory that the process was adopted on a production line basis.

A table-type airless blasting machine, manufactured by American Wheelabrator & Equipment Corp., Mishawaka, Indiana, was installed to peen all of these parts after casting, prior to machining and testing.

The machine selected for this particular job has a 27 3/4" diameter individual tables mounted on a spider. The design is such that as the main spider rotates, these small tables automatically rotate by themselves, under the blast of metallic abrasive centrifugally hurled from a rotating wheel mounted in the rear of the cabinet.

Such a design permits one man to perform both continuous loading and unloading without changing his position. Peening is uninterrupted.

While parts are compact enough to withstand a gentle tumbling action, the tumble-type blasting machine is usually selected, as it requires less attention from the operator and is capable of even faster production rates. A continuous rubber apron-type belt forms the blasting compartment and automatically cascades the castings under the shot blast.

The operator during this time can be attending to other jobs. Unloading of the machine is also done automatically by reversing the direction of the motion of the belt. Cylinders for outboard boat motors, and similar parts, are usually processed in this type of machine.

Leakage for this manufacturer of hydraulic cylinders dropped in one case from 50% to 20%, and in the other from 16% to 4%. It should be pointed out that in both cases most of the leakage after shot peening occurred at machined surfaces. This phenomenon is readily understandable in view of the fact that the effects produced by shot peening are limited to a thin surface of the metal. When this is removed, as happens in a machining operation, the machined surface may be considered to be in the "as cast" condition as far as porosity is concerned.

It seems likely that in cases where machining is not necessary or where peening may be done after machining, leakage in castings can be eliminated almost completely by exercising careful control in both the casting and the shot peening operations. However, certain circumstances might make it impossible to do machining first, then shot peening.

The procedure would be governed by the characteristics of the parts. In all cases, it would probably be best to present the problem to reputable and experienced manufacturers of shot peening equipment and rely heavily on their recommendations.

Photomicrographs show: top—pores structure in "as cast" condition, bottom—effect of shot peening on surface. Note that porosity is sealed off.