The Effects of Shot Peening on Pressuretightness of Nonferrous Die Castings

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ABSTRACT

The effect of shot peening on pressuretightness and corrosion resistance of non-ferrous die castings are shown and the economic benefit of shot peening is compared with impregnation process.

KEYWORDS

pressuretightness, porosity, leakage, corrosion, impregnation.

The lower pressuretightness of die castings is a general problem. After shot peening, the tightness of nonferrous die castings can be remarkably increased. The Second Automobile Works widely uses this technical process. Part of these automobile parts are shown in Fig.1.

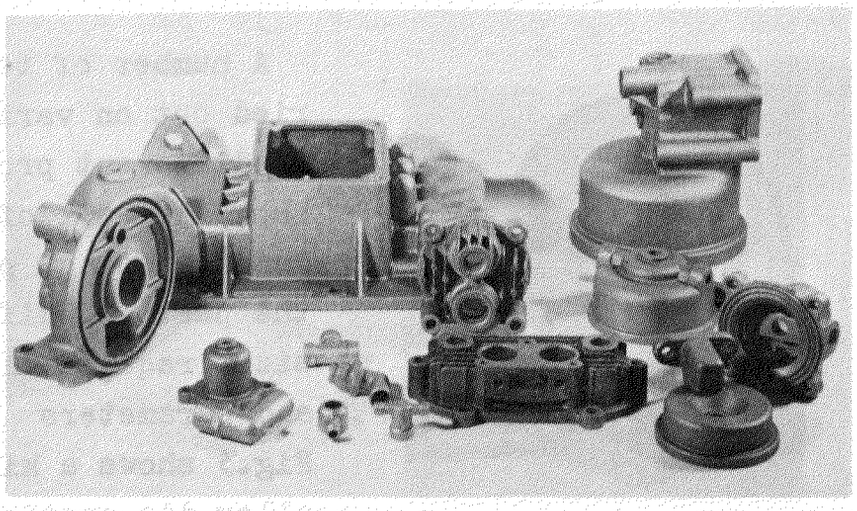
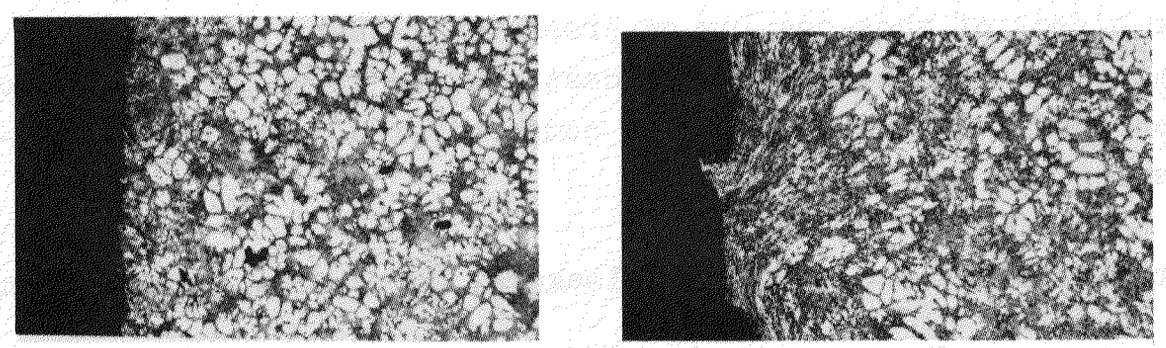


Fig.1 Non-ferrous die castings after shot peening

At present, among the automobile industries of large output production, more and more nonferrous die castings

are produced. However, by taking this process the molten metal is injected with high pressure and high velocity through fin-type in-gate into the die cavity. Part of the air in the die cavity and gas evolved from the liquid metal during filling are apt to be entrapped in the castings and forming gas holes. X-ray detection shows that the gas holes exist in castings with small and dispersed form. At the thicker casting sections or hot-spots, porosities are also easily formed due to solidification. These defects are the main cause for the leakage of die castings.

For its lower hardness, more severe plastic deformation may occur in near-surface layer of aluminum castings after shot peening. The aluminum alloy grains are broken and elongated, forming a plastic deformation layer(Fig.2).



(a) as cast 100 X (b) after shot peening 100 X

Fig.2 Microphotograph of aluminum alloy die casting surface. Steel shot diameter:0.8-1.0mm, Almen intensity:23C(mm)

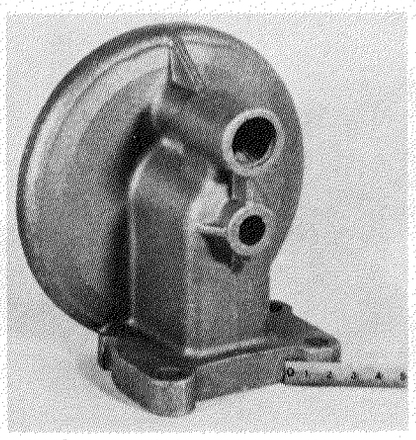


Fig.3 A shot peening casting

A number of tests have been carried out on various peening machines in different processes.The results show that all of them show effective in increasing pressuretightness,but the parts of different shapes and sizes require different equipments and parameters for optimum results. Fig.3 shows a kind of the aluminum alloy die castings.

For getting a good quality of die castings, it is necessary to make a

regular control of cast process. In commercial production, however, a number of leakage die castings is still possible. Table 1 indicates that pressuretightness of die castings can be remarkably increased by shot peening.

Table 1. The effect of shot peening on castings' leaktightness

	states	yield ratio (%)*	chemical composition (%)	shot peening specification
noymal type die casting	as cast	70	si: 9-11 Cu: 3-4 Al: rem.	tumble-type blasting machine shot: steel diameter: 0.8-1.0 mm coverage: 1.3 Almen intensity: .41A(mm)
	shot peening	95		
die casting under controlling technical parameter	as cast	85		
	shot peening	97		
leaker	shot peening	83**		

Notes: * percentage of leakless castings by leakage test.
** percentage of castings turned into leakless after shot peening.

The leakage of die castings may also be remedied by vacuum impregnation treatment. As compared with shot peening, its equipment is more complex,and production cycle is longer(Table 2). Shot peening also possesses unique advantage for cleaning up the fins of castings and improving surface quality.

The corrosion test results show, though a little amount of steel filings may remain in the aluminum castings, there is no harm in their pressuretightness(Table 3).

CONCLUSION

After shot peening, at the aluminum die castings surface, a plastic deformation layer is formed, and the subsurface layer structure becomes more compact. It can remarkably increase pressuretightness of die casting. On economic consideration, it has the advantage over vacuum impregnation process. The effect of shot peening on pressuretightness can sustain for a long time without any fading.

Table 2. Compare shot peening with vacuum impregnation

process	cost ratio per piece	man-hour ratio per piece	working area ratio	man of working posts ratio	recovery ratio of rejected parts(%)	surface quality
shot peening	1	1	1	1	83	increase
vacuum impregnation	6	10	3	3	80	no change

Table 3. Various corrosion test specifications and results

Testing item	Testing condition	Percentage of leakless parts(%)				Explanation
		240 hrs	480 hrs	720 hrs	1440 hrs	
Salt spray test	5% salt water tem. 60° C	100	100	100	100	Surface of the parts covers fully with white corrosion products
Humidity test	Relative humidity 95% tem. 60° C	100	100	100	100	Surface of the parts appears some rust spots
Natural environmental exposure	Continental climate in middle region of China Max.atm.tem. 40° C Average atm.tem.16C	All parts are leakless after testing in 9000 hrs.				Surface of the parts without any obvious change
	Wet-hot marine climate in south of China. Relative humidity 84%. Max.atm.tem. 32° C Average atm.tem.22C Atmosphere contains HCl: 0.1 mg/m SO : 0.15 mg/m HS : 0.02 mg/m NH : 0.068 mg/m	All parts are leakless after natural environmental and sun shine exposure in 3760 hrs. then keeping indoors for 3760 hrs.				Surface of the parts covers fully with white corrosion products