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# Fighting Wear and Thermal Fatigue in Die Casting Dies

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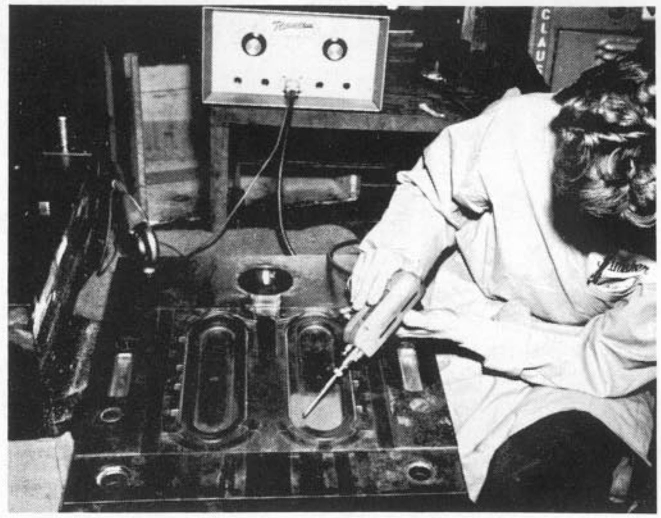
With today's emphasis on productivity, ways must be found to lengthen the life of die casting dies. Heat checking is probably the most frequent cause of failure of a die casting die. It is caused by thermal fatigue, which results from the stresses created by the alternate heating and cooling of the die surface during the casting process. When hot metal strikes the surface of the die, the die expands . . . and it contracts during cooling. Heat checks start as tiny pits which eventually line up to form a closed network of fine cracks. Eventually the cracks enlarge until they are deep enough for the casting metal to flow into the steel below the surface of the die during casting procedures. It is important not to let heat checks get too deep, as these deep cracks sometimes become too costly to remove, and the die may have to be resunk or remade entirely.

As an example, a complex die was about to be replaced at the request of a customer of a California die caster, due to severe heat checking. The castings produced had been so rough from the thermal fatigue heat checking of the die that they could cut a person's hand. In an attempt to salvage the die, the die caster used a sanding drum to remove the heat checks in the area of the gate. Tungsten carbide was electronically applied to three different die cavity areas. First, the die area of heavy heat checking was polished and then tungsten carbide was deposited, as was the die area where carbonaceous compound had formed on the die or die sprayed areas. In the third area, the die was impregnated with tungsten carbide in an area where the die had an exceptionally heavy wall, approximately 0.375 in. or more, where the aluminum adhered to the die on the surface. The tungsten carbide treatment was applied with a Rocklinizer, a gun-type metal impregnator.

The desire was to provide a test to determine if the process would be successful in alleviating these three different conditions on the same die. The die was successfully salvaged and has run approximately 35,000 pieces, and the parts are still useable. The die can be Rocklinized again without any surface preparation, to further extend its useable life. It is possible to reduce the tendency for heat checking to occur on a new die by treating it on a preventive maintenance basis. Also, dies can have extended overall life as well as longer runs without maintenance if the tungsten carbide is applied before heat checking exceeds acceptable limits.

The gun electronically impregnates and deposits wear-resistant material both on and within the metal surfaces. Manufactured by Rocklin Mfg. Co., Sioux City, Iowa, the units offer deposit capabilities ranging from 0.0001 in. to approximately 0.004 in. in a single application, controllable within 0.0001 in. by machine dial setting. The electrode is placed in light contact with the workpiece to generate time-released arcs throughout the area to be protected without stress or distortion. No appreciable heat



**Rocklinizer used to apply tungsten carbide to die cavity.**

is generated, and the deposited electrode material will not separate or flake off. No subsequent grinding, honing, or lapping is necessary after Rocklinizing.

There are other die areas that can benefit by treating with tungsten carbide, including runners, overflows, and vents. The vents on a die stay much cleaner when they have been carbided. Minor cracks in a die can be covered with tungsten carbide as long as they have not been allowed to progress to a width greater than 0.001-0.002 in.

Galling and seizing of cores is another problem. The thermal expansion of zinc and aluminum die cast metals is much greater than that of the steel core. The metal shrinks onto the cores, thus resulting in extreme pressure at the core section. When treating with wear-resistant material, it will appear that the core is too rough to release the casting. However, this roughness is so shallow that the core actually makes the casting smoother because the aluminum will not adhere as much as it does to a core that has been stoned to a high polish. The cores with a carbided surface make the lubricant or die release agent adhere better to the steel, thereby providing a nicer finish on the cast parts.

The Rocklinizer has dial settings which can control the amount of tungsten carbide deposit in increments of 0.0001 in. On small cores lower dial settings are used; higher dial settings and, accordingly, a greater deposit, are available for larger cores. Some experimentation with depth of deposit is necessary to maximize the benefits of applying tungsten carbide. Tungsten carbide has also been successfully applied to rework areas of fits on slides to reduce galling.

Soldering of the zinc or aluminum casting material to the die surface also is a cause for rejection of many castings. Carbiding prior to a production run has eliminated soldering at gates, vents, parting lines, and the die cavity, where molten metal has a tendency to solder to the cavity.

Ejector pin flash can be eliminated if the die is in fair condition before treating. (Of course, a completely worn out hole cannot be repaired.) Tungsten carbide applied to the ejector pin about 1 in. back from the face of the cavity has been used successfully. Users report needing less lubrication, which results in a better finish on the die casting. They also find such treatment valuable in building up fixture locators on close-tolerance automatic equipment.

The end result of applying wear-resisting materials to tooling in the die casting industry will be less of the following: machine downtime, idle time for the operator, die removal and reinsertion time, inspection time, and die maintenance. The bottom line of this surface treatment: increased productivity and reduced production costs.