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The most significant attributes that are needed for dies used for die casting or squeeze casting are:

Resistance to thermal fatigue.

- Minimize softening of die.
- High fracture toughness.
- Removal of residual stress.

Other properties such as erosion/washout reduction and soldering resistance are also important, but can be influenced more by die filling conditions and statistical process controls. We will discuss in future bulletins **additional benefits of MetaLife®** that also help in these areas.

In the previous March issue ofour newsletter, we began our discussion of the “K” value formula and how the parameters presented affect die thermal fatigue. The **higher the “K” value, the more resistance to thermal fatigue.**. Examining the formula we see that increased thermal conductivity and yield strength are directly proportional to obtaining optimum K values while thermal expansion and modulus of elasticity properties are in directly proportional to a high “K” value.

Almost all premium grades ofH-13 steel have sufficient percentages of molybdenum ranging anywhere from .90% to 1.85%. Martensitic steels are fairly good for both a high thermal conductivity and low thermal expansion, while austenitic superalloys are not as good. The modulus of elasticity is difficult to change. **High yield**

Some of these show significant improvements in the reduction of heat stress cracking along with higher charpy impact values. One of these is KDA1, a steel originally

One of these is KDA1, a steel originally produced and sold by Nippon Koshuha Steel Co., Ltd. in Japan. The steel is now available and being sold in the US. One of the lab specimens of this steel that was austenitized at 1925 degrees F and oil quenched showed almost **no cracking after 20,000 dunks** in the accepted **Case Western Dip Tank Test.** Charpy impact values at normal elevated temperatures of 300 to 400 degrees F were in the range of 20-33ft.lbs. Also no measurable die softening occurred after completing 20,000cycles in the dip tank. The rockwell value on the specimen maintained its original 45Rc hardness. Bear in mind that these specimens, as well as the other types of steel tested, were specially heat treated. Some die casters on the west coast, however, are using the KDA1 material and receiving similar benefits without doing any special heat treatment to the steel.

Could this be the steel of choice or will one of the other types also being tested show promise? It is important to remember that **even with** these **new steels, stresses will eventually build-up that must be removed and countered with** periodic heat stress tempering and **MetaLife®** when the die is NEW after sample approval and periodically through the life of the tool.

This concludes our tutorial on the modes and causes of die failure relating to Die Stress and Thermal Fatigue. In **subsequent issues**, we **will examine and discuss the remaining modes of**

strength should be maintained with continued use to avoid die softening.

NADCA's Die Materials **Committee projects are currently evaluating new types of hot work steels.**

failure which include Mechanical **Erosion** or Washout, and Chemical/Mechanical **Soldering.**
Some encouraging work using coatings to reduce soldering and oppose erosion is being done by Ohio State in conjunction with NADCA and the Die Materials Committee. Badger Metal is also active with field tests using **MetalLife®** as the substrate treatment for these state of the art coatings.

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