

CT-78, Development of an As-Cast Martensitic Alloy for Rapid Prototype Tooling and Near Net Mold Production

The objective is to develop a working knowledge of an alloy composition discovered by Global Manufacturing Solutions and to reduce lead times and cost of prototype and production tooling by elimination of heat treatment. The new alloy exhibits the properties of through-hardening followed by auto-tempering during a slow cool from the austenitic temperature range. This means that it can be cast directly into the form of the tooling or mold configurations, and during slow cooling it transforms to martensite followed by auto-tempering of the martensite to result in a fine tempered martensitic structure at room temperature, exhibiting hardnesses in the range of HRC 40 to HRC 50. The tooling can then be final machined or ground to final configuration with no need for subsequent heat treatment. This will allow for rapid, inexpensive production molds and tooling directly from casting. The casting will exhibit a hard uniform tempered martensitic structure through its thickness. The ultimate goal of this project is to significantly reduce the lead times and cost associated with the procurement of prototype and production tooling while at the same time enhancing our regional competitive posture.

This alloy system lends itself perfectly to the rapid prototype tool production process. A tool can be computer designed and a prototype built from the design using SLA or any one of several other rapid prototype techniques. A casting can then be made from the SLA prototype to produce hard tooling. The hard tooling will exhibit a tempered martensite microstructure directly from the casting process and only require whatever finish machining or grinding necessary to complete the tool. The result is a finished tool in an equivalent condition to a quenched and tempered tool steel but without any need for the heat treatment process. This eliminates all of the problems of warping and stress cracking that can occur during a heat-treating process. It allows for the direct production of more complicated and difficult to produce tools without all of the finish grinding usually necessary after the tool has been hardened by heat treatment. The end result is a production quality tool, made by a rapid prototype method that if it produces the parts desired can instantly become production tooling. Because of the uniformity of microstructure, this tooling would be expected to be stable for its useful wear life. This method could then be repeated to make production tooling with any changes that might need to be incorporated, in a fast and inexpensive manner. Production of quenched and tempered tooling in this fashion can only help to aid in America's industrial and Defense industry's competitiveness.

Task Leader: Dr. Charles Woods, Global Manufacturing Solutions - 513-743-9933