Fortron® PPS Selected by Airtex to Gain Design Freedom, Mechanical Integrity for Auto Water Pump Impellers in Aggressive Coolants

When Airtex Products in Fairfield, Illinois (USA), developed six new water pumps for cars made by U.S. automakers, it chose Fortron® polyphenylene sulfide (PPS) for its impellers rather than aluminum or cast iron. Fortron PPS from Ticona, the technical polymers business of Celanese AG (NYSE: CZ), enabled Airtex to develop complex impeller geometries that enhance efficiency and provided the needed mechanical integrity and dimensional stability in the face of continual immersion in aggressive coolant solutions at temperatures to 130°C.

Water Pump Design and Operation
The water pumps, which are 4 to 15 inches in diameter (10 to 38 cm) and 3.5 to 8 inches wide (9 to 20 cm), circulate coolant through the radiator and engine at rates of 30 to 100 gallons/min. (110 to 380 liters/min.). The pumps are powered by a belt off the crankshaft and operate when a thermostat indicates engine temperatures above a threshold value. The impellers have diameters of 2.5 to 4 inches (6 to 10 cm) and widths of 0.2 to 1 inches (0.5 to 2.5 cm). They rotate at rates as high as 8,000 rpm.

“Impellers made of Fortron PPS are practically trouble-free,” says Curt Ulm, Director of Engineering at Airtex. “This is impressive because they must retain their size and strength in a tough chemical environment.”

“Today’s glycol ‘long-life coolants’ contain organo acid inhibitors that prevent particulate formation and so extend coolant life to 100,000 miles. Unfortunately, these inhibitors can attack aluminum and many plastics. In developing the impellers for these pumps, we considered resins such as polyphthalamide and several nylon derivatives, but these did not perform as well as PPS.”
Ulm says Fortron PPS withstands the mechanical stresses of rapidly changing RPMs in this high-heat, acidic environment. “The polymer’s dimensional stability keeps the impellers from deforming under the high rotational torque and uneven pressures in the pump. This can involve a 30 to 40-psi differential across the face of the impeller.”

**Design Flexibility and Future Applications**

“The design flexibility we get with Fortron PPS is also important. It enables new geometries that promote efficient interaction between the impeller and the fluid. It also helps us fit our pumps into the underhood space auto designers define for them.”

“PPS is likely to play an expanded role in our future water pumps,” says Ulm. “For instance, if automakers switch from mechanical to electrical water pumps, we may use Fortron PPS in the pump housing instead of metal to reduce weight and gain production and design efficiencies. This switch is possible because electrical pumps, which are infinitely variable in speed, impose much less torque on the pump body than do today’s mechanical models.”

**Related Literature**

Several related publications that can provide additional information on Fortron PPS are:

- Fortron PPS Chemical Resistance Guide
- Fortron PPS Product Brochure (B240)
- Designing with Fortron PPS – Design Manual (FN-10)
- Designing with Plastics – The Fundamentals (TDM-1)