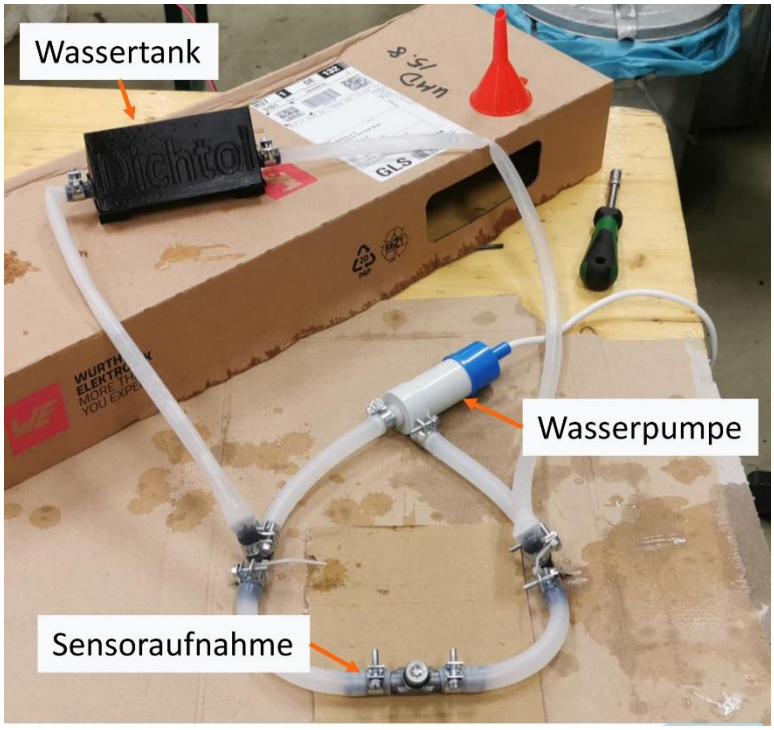
UMD racing team successfully seals additively manufactured components for the vehicle cooling system of a prototype with dichtol AM from DIAMANT

In order to make additively manufactured components for the vehicle cooling system of a Formula Student prototype watertight, the UMD racing team at the University of Magdeburg successfully tested dichtol AM under racing conditions. The first tests have already shown that the product from DIAMANT guarantees reliable sealing of the sensor holder made of ASA filament, which fulfils the high demands placed on the cooling system. The sensor mount was successfully installed in the racing car and worked reliably for an entire season under real conditions. The principle of impregnating additively manufactured components with dichtol AM is easily transferable to small series production. Tests on the impregnation of the PETG water tank have also shown that the combination of additively manufactured components and dichtol AM offers enormous potential, and not just in racing.

The UMD team has already sourced components from the SLS process in the past via a long-standing sponsor. When looking for a solution to make additively manufactured components for the vehicle cooling system of a prototype watertight, the sponsor recommended dichtol AM from DIAMANT Polymer. Thanks to its own production capacities in the FDM process, it was only logical for UMD-Racing to carry out tests on parts of the cooling system using dichtol AM.

Successful leak tests under racing conditions

In Formula Student, UMD Racing works under prototype conditions where speed and innovation are required. As many components of their racing car rely on complex geometries, the FDM process offers the most cost-effective way of producing components. However, process-related defects cannot be completely ruled out in additive manufacturing, which can be sealed by impregnation.



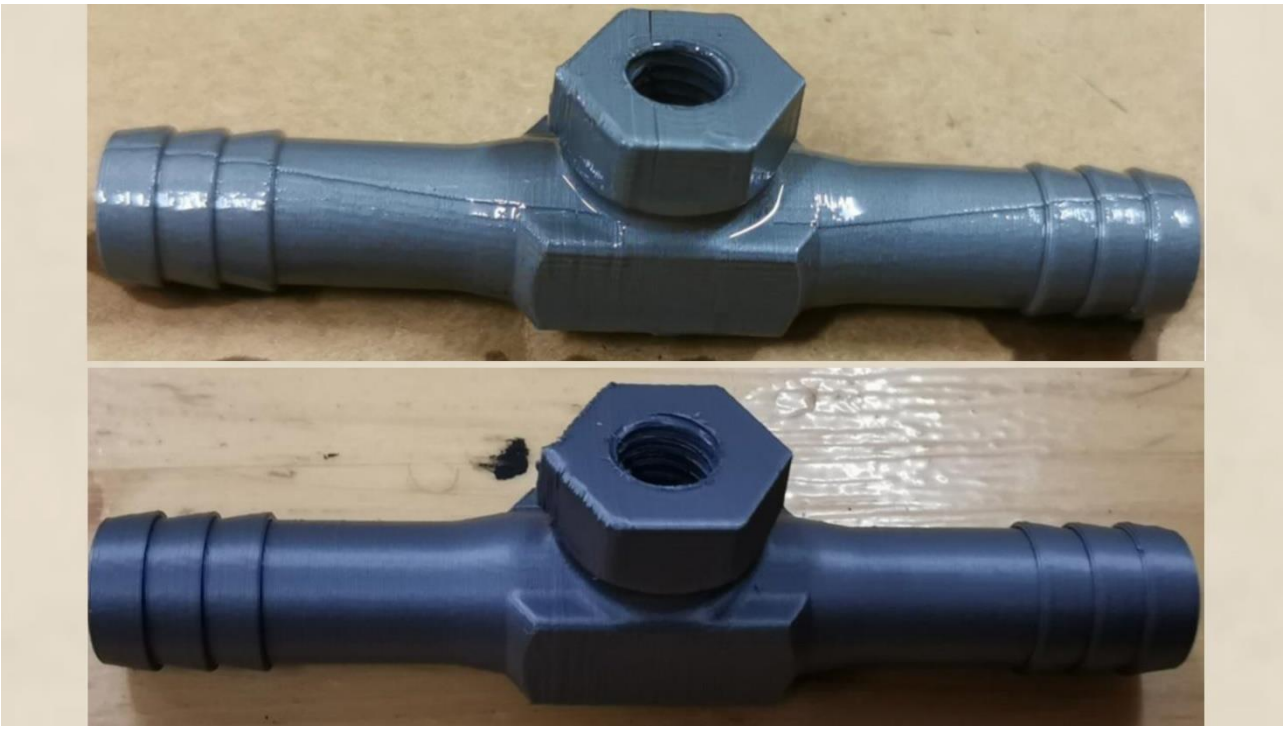
The relatively small water circuit of the UMD-Racing prototype consists of a water pump, two T-pieces, a sensor holder and a tank as buffer storage.

A key requirement for the cooling system is absolute tightness. This is because the consequences of a leak in the cooling system are serious. As soon as the system loses fluid, the water pump can no longer pump the coolant and air enters the system. This leads to a loss of cooling capacity, which results in expensive components such as the electric motor and the inverter overheating. In the best-case scenario, there is a temporary loss of power; in the worst-case scenario, the safety shutdown of the entire vehicle is triggered or irreparable damage is caused.

High-performance polymer for infiltration, impregnation and sealing

dichtol AM is a very low-viscosity, high-performance polymer for infiltrating, impregnating and sealing porous structures, layers and components. dichtol AM penetrates porous structures and cracks independently and seals them permanently and reliably. The product has a very high capillary activity and cures without the addition of heat under ambient conditions. It is applied atmospherically, i.e. without vacuum or pressure. The cured polymer fills the open pores or cracks and has good resistance to oils, lubricants and coolants.

In order to fulfil the high demands placed on the cooling system and avoid dangerous leaks, additively manufactured components were impregnated with dichtol AM on a trial basis - with impressive success. The first tests have already shown that the product reliably guarantees tightness, especially for components manufactured using the FDM process. The dichtol tests were carried out with the sensor holder made of ASA filament and the water tank made of PETG.



To impregnate the sensor holder, the component, which was additively manufactured from ASA filament, was completely immersed in the liquid dichtol AM for around five minutes and made watertight (top image). The non-infiltrated sensor holder (bottom image) already exhibited leaks without the pump being switched on, as it had a small crack caused by the manufacturing process.

Sensor mount impregnated with dichtol lasts the entire racing season

The sensor holder is a central component that integrates the pressure and temperature sensor into the UMD Racing cooling system. Thanks to 3D printing, it was possible to realise a complex, compact and ultra-lightweight design that would hardly be possible using conventional methods. At the same time, impregnation with dichtol AM enables reliable sealing that fulfils the high racing requirements in the cooling system. The sensor mount impregnated with dichtol AM was successfully installed in the racing car and functioned reliably for an entire season under real-life conditions.

The PETG water tank was initially used for tests to check both the tightness and the performance within the cooling system. Although PETG does not fulfil the high temperature requirements of the vehicle, the tests have shown that the combination of additively manufactured components and dichtol AM offers enormous potential. The PETG water tank has so far been used for test purposes. The results are promising, so that the use of impregnated tanks made of high-temperature-resistant plastics is planned for future prototypes.

With the help of dichtol AM spray, the PETG water tank (like the sensor holder infiltrated with dichtol AM) could be sealed. Although PETG does not fulfil the high temperature requirements of the vehicle, the tests have shown that the combination of additively manufactured components and dichtol AM offers enormous potential.

Efficient sealing of all additively manufactured components in the cooling system

dichtol AM can be used universally and is suitable for sealing all additively manufactured components in the cooling system. These include T-pieces, reducers and water tanks - typical components that can be found in almost every water circuit. In addition to cooling system components, impregnation is also suitable for covers and housings of electronic components. Electronics in racing cars are often exposed to adverse conditions such as splash water and cannot always be installed with protection. With dichtol AM or the practical dichtol AM spray, even larger housings can be reliably sealed, which significantly increases the safety and service life of sensitive components.

In addition to UMD Racing, at least four other Formula Student teams are using dichtol. As UMD Racing's racing car is a one-off, no small series will be produced. Nevertheless, the principle of impregnating additively manufactured components with dichtol AM is easily transferable to small series production. It is also an attractive, cost-effective way for the UMD team to apply the technology to other components.