Stanyl® Diablo

Unprecedented thermal stability and strength retention for under-the-hood components

High heat resistant Stanyl® Diablo OCD2100

New technology recently developed and patented by DSM Engineering Plastics further extends the functional life of under-the-hood components. By limiting thermal degradation, the new Stanyl® Diablo OCD2100 can withstand exposure to continuous temperatures of up to 220°C for more than 7,000 hours with less than 15% loss in mechanical properties. Competitive materials typically degrade to powder long before 10,000 hours.

DSM makes this claim after extensive development and evaluation, along with customer application testing of the new high-heat resistant material for under-the-hood applications such as air ducts. Following the presentation of the new material at K2007, the international plastics and rubber trade fair, Stanyl Diablo OCD2100 for air ducts was released commercially in November 2007. The commercial launch of Stanyl Diablo OCD2100 once again reinforces the DSM's position at the forefront of innovative materials for the automotive industry.

Successfully specified for automotive applications for almost 20 years, Stanyl offers excellent stiffness at elevated temperatures as well as extended fatigue endurance and outstanding wear resistance. This combination of properties has made Stanyl one of the key materials used in automotive components through which the turbo charger feeds compressed hot air to the combustion chambers, specifically hot side charged air ducts and charged air cooler end caps.

Heating up

DSM's decision to develop the new high-heat resistant Stanyl Diablo was spurred on by the pressing demand from car manufacturers for thermally stable thermoplastics to withstand under-the-hood temperatures of 210^0C and higher generated by turbo charging engines. At present, some eight million turbo diesel cars are sold per year in Europe and the market for both diesel and gasoline turbo-charged engines will grow in the USA and Japan.

Innovations particularly under-the-hood are being fuelled by the increasing pressure on the car industry for cleaner technology that translates to greener solutions. As well as customers and end users wanting cleaner transport, European legislation (EURO V and VI) is exerting stricter requirements for reductions in greenhouse gas emissions while calls for measures to reduce fuel consumption are becoming ever stronger.

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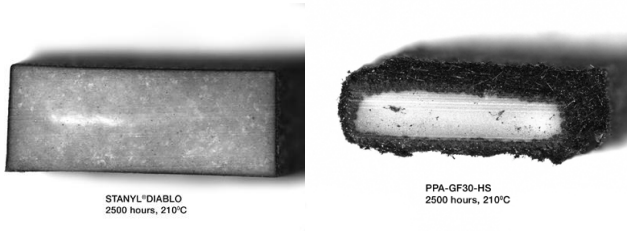
As a result, the last decade has seen the appearance of a new generation of vehicles with smaller engines with higher turbo pressure, and this trend will continue in the coming decade. As well as cutting weight, the goal is to reduce fuel consumption by maximizing power generated from each liter of fuel. These developments and the introduction of related technologies, however, have led to less space under the hood but more significantly to higher temperatures in this confined space. As a result components such as air ducts, air intake manifolds, and charged air cooler end-caps are exposed to continuous operating temperatures up to 210^0C and even higher.

High heat resistance

Higher thermal loads and tougher life-time requirements have serious implications for materials used in under-the-hoot components. OEMs and suppliers can no longer rely on standard polyamides to give continuous heat resistance under the new high temperature conditions created by turbo diesel engines. In fact, the life expectancy of all high-performance thermoplastics deteriorates as temperatures rise above 190°C. Resins exposed to constant high temperatures become thinner and loose strength as a result of oxidative degradation.



Improved long-term stability of Stanyl Diablo, visualized in cross sections of thermally aged natural colored test bars.

Building on its position as a supplier of innovative materials, DSM investigated how to retain the mechanical properties of Stanyl under the new high heat requirements. “We realized that delivering improvements in long-term thermal stability would not be a matter of evolution, for instance by adding more stabilizer to the resin”, explains Product Manager Stanyl, John van den Bungelaar. “A completely new concept was needed. We had to find out exactly what happens to Stanyl at high temperatures and this called for intensive investigation of the breakdown mechanisms. How is the polymer matrix affected by exposure to such high temperatures. We had to identify the specific material properties to be controlled in order to develop a new generation of high temperature resistant Stanyl grades.”

Willy Sour, Product Development Specialist Stanyl, stresses that fundamental knowledge about the degradation mechanisms was the key to the development of the new high-heat resistant material. “Stanyl Diablo does not rely solely on traditional anti-oxidants, as is the case with other comparable products on the market. On the contrary, deterioration of mechanical properties can be effectively reduced by controlling the oxidation mechanism. Extensive investigations have shown that the degraded layer of conventional polyamides cracks and that cracking accelerates degradation which increases deterioration of properties. Thus it was essential to control both chemical and physical processes, whereas traditionally the focus has been on the chemical process only.”

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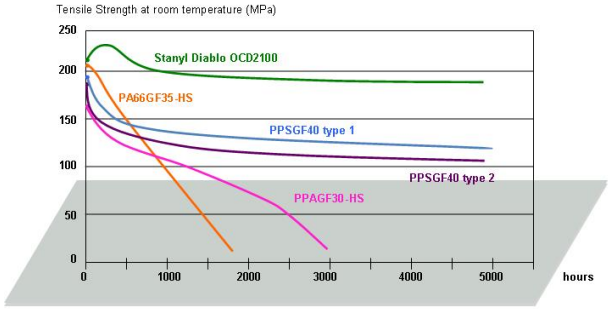
By limiting thermal oxidative breakdown, STANYL Diablo OCD2100 has been demonstrated to withstand more than 7,000 hours temperature exposure up to 220°C with less than 15% loss in mechanical properties.

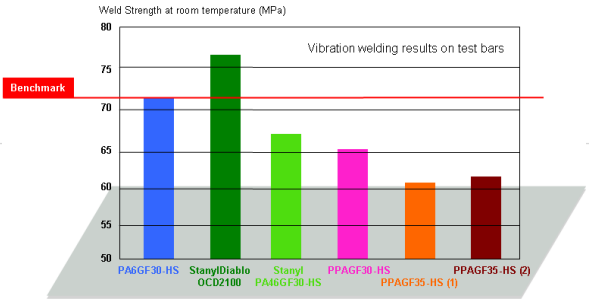


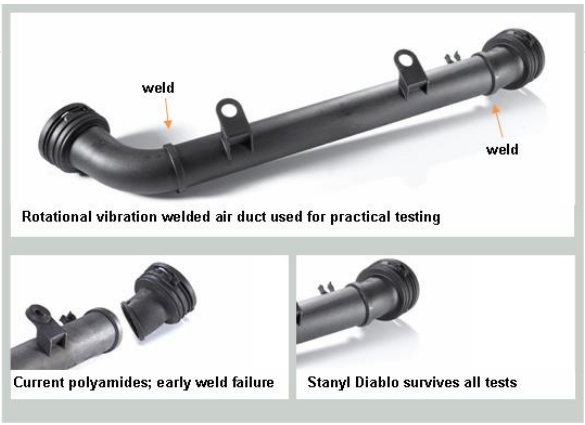
Weld strength

At an early stage, even before all the properties had been fully optimized the project team asked customers to test two development versions of the Stanyl Diablo. Research and Technology Manager Stanyl, Wilma Nijenhuis explains, “We can test a wide range of properties ourselves but it is even better if they can be tested in specific applications. In this case, customer involvement led to a win-win situation. This preliminary work gave these customers a year’s lead over their competitors, and tests with customer applications were crucial to determining the further direction of our development process.”

Willy Sour takes up the story, “Although we were focusing on both air ducts and cooler end caps in turbo diesel engines, we had expected the best fit would be for the cooler end caps. However, customer feedback indicated that Stanyl Diablo is highly suitable for hot charge air ducts. This conclusion stemmed from a property that had not originally been a key focus in the development process – the greatly improved weldability and weld strength. This is a vital consideration for hot charge air ducts, which are typically made of two components welded together; the weld is the weakest point.”

For two shell welded air ducts that are injection molded, the aging performance of the weld is essential. In this respect, Stanyl Diablo OCD2100 has been shown to outperform current high heat resins not only on high temperature stability, but also on weldability, weld strength and the long-term heat stability of the weld. Furthermore, material’s low creep and fatigue behavior contribute to longer and better reliability of parts for the lifetime required.





The development team lead by Willy Sour is working on a new grade of Stanyl Diablo suitable for use in charged air cooler end caps that is targeted at higher continuous temperatures up to 250^{0}C and for other applications.

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