New legislation places very tight limits on car emissions, with strict targets that must be met as early as 2015. DSM focuses on driving forward solutions that significantly decrease environmental impact, leading to the development of a complete portfolio of thermoplastic products that answer the changing needs of the automotive industry.

One of the latest developments in turbo systems is to integrate the charged-air cooler (CAC) into the air intake manifold (AIM), using liquid to more effectively cool the air instead of air-to-air systems. This drives up the temperature in the AIM (currently up to 230°C), as well as the mechanical requirements for the materials used. Integrating the CAC into the AIM reduces the length of piping previously needed to reach the air-to-air cooler in the front of the car, leading to increased engine responsiveness. For car manufacturers, this makes it possible to deliver higher performing engines while still meeting the new emission limits.

DSM offers a complete portfolio of high-performance materials for air intake manifolds whether they have an air-to-air CAC or an integrated liquid-cooled CAC. This includes Akulon® polyamide 6, Akulon Diablo and Stanyl® Diablo polyamide 46. Diablo technology is engineered specifically for elevated continuous-use temperatures of 180-230°C and peak temperatures up to 265°C.

**AIM with integrated liquid-cooled CAC**

Air intake manifolds with integrated liquid-cooled CACs achieve a giant step forward in improving engine responsiveness and reducing turbo lag, yet they require a great deal more from the plastic materials used to create them. Integrating the cooler into the AIM drastically changes the geometry of the manifold in a way that could cause a loss of stiffness and strength, which are critical at higher temperatures. The new geometry also requires materials with high weldability and weld-aging resistance to maintain the part’s integrity. At the same time, the material must withstand exhaust gas recirculation (EGR) and blow-by.

**Outperforming the competition: Stanyl Diablo**

DSM’s solutions for high temperature and high pressure applications are Stanyl Diablo OCD 2100 and OCD 2300. This high-heat thermoplastic outperforms competitive materials in thermal oxidative stability, maintaining high stiffness at elevated temperatures and pressure loads.
**Best-in-class: Thermal stability**

This injection molding grade has excellent mechanical strength to provide best-in-class weld strength and ensure part integrity under oscillating pressure loads. Stanyl Diablo, like our other grades for intake systems, withstands the current exhaust gas recirculation (EGR) and blow-by requirements. It maintains high stiffness, even while exposed to continuous-use temperatures up to 230°C.

**Best-in-class: Welding strength**

Stanyl and Akulon offer excellent weldability for injection molded ducts. This next-generation material eliminates the need to return to metals due to the increasing temperature requirements under the hood, and increases the possibility to integrate functions and be more flexible in designing efficient parts. Stanyl provides a weight reduction of up to 40% over aluminum, and its optimized processing characteristics reduce material and production costs.

**Akulon® polyamide 6, the proven solution**

For lower temperature AIM applications, Akulon polyamide 6 glass-filled, provides an optimal balance between density and mechanical properties. For increased safety and flexibility in manifold design, we also offer grades with improved burst pressure or laser weldability. High-flow grades can be processed with reduced cycle times, using less energy in production and achieving an increase of up to 25% in molding productivity, as well as an improved surface finish. Akulon Diablo fills the gap between Akulon and Stanyl OCD2100 by combining long term heat aging performance and mechanical properties at 180-200°C.

**Case: Award-winning air intake manifold design**

Volkswagen’s TSI engine provides customers with both the joy of driving, and the joy of saving – on fuel and emissions. Working together with Röchling Automotive AG & Co. KG, DSM helped to develop the automotive industry’s first serially produced air intake manifold with an integrated liquid charged-air cooler, one of the key advanced engine technologies used in the TSI engine. The new design led the two companies to win the 2012 Automotive Innovation Award (Powertrain Segment) from the Society of Plastics Engineers – Europe.
Created in DSM’s Akulon polyamide 6, this pioneering advance achieves a 20% reduction in the number of parts, weight and costs over similar turbo systems with air-to-air charged air coolers. The compact solution also realizes a 40% reduction in engine compartment package space and air volume, improving engine responsiveness and virtually eliminating turbo lag, while also creating more design possibilities under the hood. This new design paves the way for the future of air intake manifolds, making a significant contribution to cost-effective, high-performance and reliable engines with high torque, low fuel consumption and minimal CO2 emissions.

“This is a real breakthrough,” says Marco Barbolini, Product Manager at Röchling Automotive. “Realization of the fully integrated air intake manifold was a challenge, however the trend toward this basic design is gaining momentum throughout the industry. Integrating the heat exchanger into the intake manifold reduces air volume to give the engines more punch, and eliminates a number of rather expensive parts.”

25 years’ experience in air induction systems

DSM, inventor of Diablo technology, has more than 25 years of experience supplying material for air induction systems. Combining our application development expertise with the extensive knowledge base of our fundamental research team, we help to determine which material properties are needed for air induction applications.

Contact us today to discuss how DSM can help redesign your air intake manifolds to integrate a liquid charged air cooler, and create lighter and more efficient air induction systems.

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