Industrial Specialties

CERAVANCE™
Binders for Advanced Ceramic Processing

Enabling superior product quality, higher throughput and lower costs
Extrusion is a well-known and established ceramic shaping method. For example, ceramic honeycombs for diesel particulate filters and catalyst carriers or multi-channel tubes for ceramic membranes are made by extrusion.

The rheological properties of ceramic masses strongly depend on the preparation (mixing, kneading) and composition of the mass. Flowability and process parameters must be adjusted exactly to the particular extruded profile to obtain defect-free parts also at high capacities. Organic binders are widely used to control the technological parameters required for ceramic bodies. They act as viscosifyer, plasticizer, lubricant and rheology modifier.

Today, many different cellulose ethers are used as extrusion aids, however, they are standard grades which have originally been developed for other applications and therefore do not necessarily fit in the best way to the rheological demand of the extrusion process.

Consequently, they do not necessarily lead to the best process parameters and to the highest product performance and generally result in a high rate of defect or off spec material.

To address this market gap, Dow has developed CERAVANCE™, an innovative line of binder systems that enable faster extrusion, improved shape retention, and help to generate less rejects. CERAVANCE™ enables customers to improve their total cost structure by increasing throughput, reducing rejects, maintenance and energy costs.

For many years, METHOCEL™ F and E chemistries have set the technical standard in the extrusion of ceramic pastes for different end uses. The shape retention of the extruded products as well as the plastic and elastic paste properties are valued by the industry.

Compared to the Above Industry Standard, CERAVANCE™ Offers:

1. Improved Product Quality: improved shape retention while maintaining plastic and elastic paste properties
2. Increase productivity: reduce manufacturing time
3. Reduce manufacturing costs through
   • Reduction of rejects
   • Reduction of water consumption
   • Reduction of maintenance costs
4. Improve sustainability through lower water consumption and reduction of rejects
Along with CERAVANCE™ product range specifically designed for ceramic paste extrusion, Dow continues to offer a broad portfolio of cellulose ethers standard grades sold under the brand names METHOCEL™, WALOCEL™ and CELLOSIZE™ as well as POLYOX™, a class of poly(ethylene oxide) lubricants. CERAVANCE™ products enable increased product and process performance and sustainability while simultaneously reducing processing costs and maintaining plastic and elastic paste properties. It also allows for extrusion of larger profiles where cooling capabilities often limit the extrusion speed.
CERAVANCE™ can improve the shape retention of the extruded ceramic by up to 25% (measured as wet green bending modulus).

CERAVANCE™ can significantly increase the strength of the extruded ceramic. This is a result of the increased wet green density which grows by 4 to 5%.

CERAVANCE™ reduces the spring back of the extruded ceramic by a factor of 3 to 4.

A ceramic paste using CERAVANCE™ shows similar plasticity, measured as wet green elongation at break, to a ceramic paste using a classical cellulose ether (industry standard).
Higher Extrusion Temperature

The higher gelation temperature of CERAVANCE™ in the ceramic paste enables a higher production speed versus industrial standard cellulose ether.

Reduce Manufacturing Costs and Increase sustainability

Around 10% less cooling water or cooling energy is required, as the paste accepts higher processing temperatures. Those 10% gain can be critical to enable extrusion of larger profiles where cooling capacity are often limiting the extrusion speed.

Combined with the increase in extrusion speed and productivity, the water/energy saving generated by the use of CERAVANCE™ improve the total cost structure of ceramic extrusion.

Furthermore, CERAVANCE™ allows for the reduction of maintenance costs due to lower abrasion of the die, screw, kneader and other machinery parts leading to longer life times and longer operation time.

Faster extrusion and less use of water improve total cost structure and sustainability

The sustainability of the extrusion process is not only improved by the reduction of water consumption (-10%) but also by the reduction of cooling energy.
**Improved Product Quality**

**Experimental Focus**

**Improved Shape Retention**

Shape retention of the extrudate measured as wet green modulus of CERAVANCE™ and Industry Standard at different addition rates in the paste. CERAVANCE™ increases the shape retention of the extrudate by up to 27% at 2 pph, 19% at 3 pph, and 13% at 5 pph. Even at high addition rate, CERAVANCE™ significantly improves product quality.

**Increased Density of Extruded Ceramic**

Wet green density as a function of the binder addition rate, compared between a classical cellulose ether and CERAVANCE™, single screw extruder, cordierite precursor formulation. In all trials the water demand was adjusted to the same stiffness. CERAVANCE™ is leading to higher wet green densities of 4 to 5%.

**Reduced Spring Back of Extruded Ceramic**

Spring back (linear expansion of the paste after leaving the die) as a function of the binder addition rate, compared between CERAVANCE™ and a standard cellulose ether, in a single screw extruder. CERAVANCE™ reduces the spring back of the extruded ceramic by a factor of 3.5.

**Maintained Plastic and Elastic Paste Properties**

The plasticity of the paste is measured as wet green elongation at break at different concentrations of the binder in the paste. Pastes with CERAVANCE™ show similar plasticity to pastes with classical cellulose ethers.
Higher Extrusion Speed
Experimental Focus

Higher Extrusion Temperature

- Defect formation of ceramic paste using CERAVANCE™ starts 11°C later than in a ceramic paste using industry standard cellulose ether. The higher gelation temperature of CERAVANCE™ in the ceramic paste compared to a classical cellulose ether enables a higher production speed.

Higher Extrusion Speed

- Extrusion output speed, compared between a classical cellulose ether and CERAVANCE™, single screw extruder, cordierite precursor formulation, 4 pph parts cellulose ether. Water adjusted to Shore – hardness 11.3 - 11.6. CERAVANCE™ allows for an increase of extrusion speed of +45%.

Reduce Manufacturing Costs and Increases Sustainability
Experimental Focus

To the right is a comparison of the paste water demand, as a function of the binder addition rate, between a classical cellulose ether (Industry Standard) and CERAVANCE™, single screw extruder, cordierite precursor formulation. In all trials the water demand was adjusted to the same stiffness.

To achieve constant stiffness (machineability), the paste using standard cellulose ether always requires at least 2 pph more water than the one using CERAVANCE™.

Less use of water

- Paste water demand (pph) at constant Shore hardness

- Cellulose ether addition rate (pph)
Dow requests that customers considering use of Dow products in medical applications notify Dow so that appropriate assessments may be conducted. Dow has a Corporate Medical Application Policy in place that guides the use of Dow products in potential new pharmaceutical and medical device uses. Dow reviews all new applications/uses according to this Medical Application Policy to determine if the use is appropriate for Dow materials. Dow does not endorse or claim suitability of its products for specific medical applications. It is the responsibility of the medical device or pharmaceutical manufacturer to determine that the Dow product is safe, lawful, and technically suitable for the intended use. DOW MAKES NO WARRANTIES, EXPRESS OR IMPLIED, CONCERNING THE SUITABILITY OF ANY DOW PRODUCT FOR USE IN MEDICAL APPLICATIONS.

NOTICE: No freedom from infringement of any patent owned by Dow or others is to be inferred. Because use conditions and applicable laws may differ from one location to another and may change with time, Customer is responsible for determining whether products and the information in this document are appropriate for Customer’s use and for ensuring that Customer’s workplace and disposal practices are in compliance with applicable laws and other government enactments. The product shown in this literature may not be available for sale and/or available in all geographies where Dow is represented. The claims made may not have been approved for use in all countries. Dow assumes no obligation or liability for the information in this document. References to “Dow” or the “Company” mean the Dow legal entity selling the products to Customer unless otherwise expressly noted. NO WARRANTIES ARE GIVEN; ALL IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE ARE EXPRESSLY EXCLUDED.

www.dowindustrialspecialties.com