Appliance Solutions

Supported by innovative Engineering Applications

BOREALIS

بروج
Borouge

A strong creative partner

Building on Borealis' unique Borstar® technology and more than 50 years experience in polyolefins, Borealis and Borouge provide innovative, value creating plastics solutions for the appliances, mobility, infrastructure – pipe systems, power and communications cables – and advanced packaging industries. Engineering Applications is a specialist Borealis and Borouge business segment particularly focused on the development of 'creative innovation' polypropylene (PP) solutions for appliance and automotive applications.

The appliance market in perspective

Households in both developed and developing societies around the world increasingly rely on the convenience and time saving role played by appliances. The demand for household appliances continues to increase in line with population growth and rising living standards. Urbanisation also contributes to this growing market, as it expands availability and access to appliances though centralisation. Today we see thousands of different, high quality appliances for domestic needs available on the market and the demand for and dependency on these is projected to continue growing.

Trends driving the appliance market

Growing population	
Globalisation and increasing urbanisation	
Strengthening regional economies with rising living standards	
Sustainability demands for:	
Better water and energy efficiency	
Recyclability	
More sustainable alternative materials	
Lower carbon footprint	

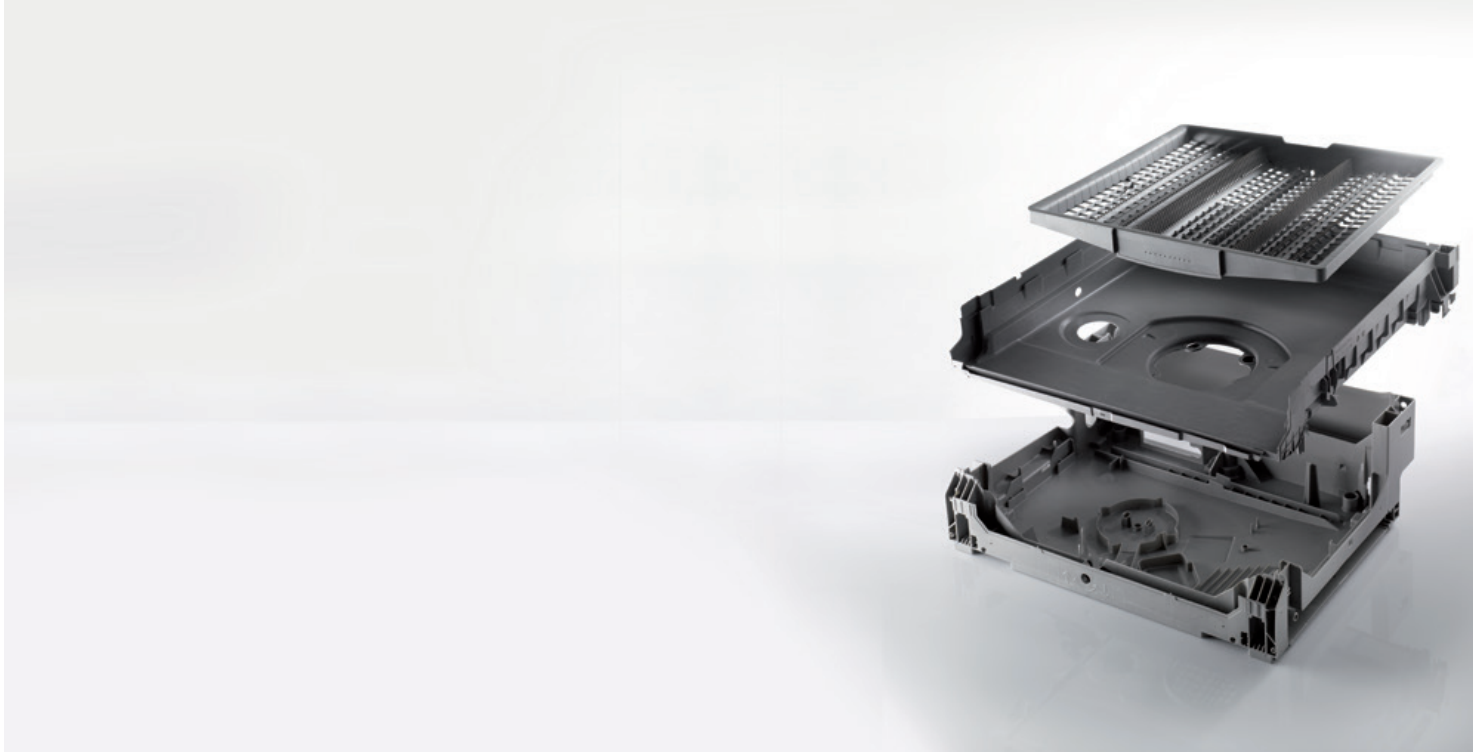
Typical appliances

White goods

Washing machines
Dishwashers
Fridges
Freezers
Dryers
Airconditioners

Small appliances

Vacuum cleaners, coffee makers, ventilators, hair dryers, microwave ovens, power tools, water kettles, steam irons, toasters, rice-cookers, tea-makers, water heaters, motor housings, consumer electronics, other household and personal care products



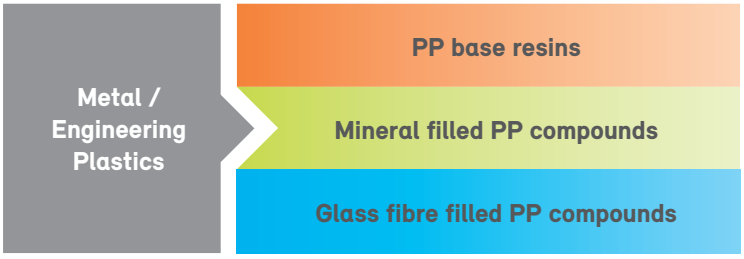
> **As one of the leading home appliance manufacturers in the world, BSH stands for values such as innovation, quality and reliability. Therefore we expect from our suppliers, innovative technology, outstanding design, best quality and sustainable products based on a proper material supply and best in class prices.**
>
> [**Michael Borne,** Head of Purchasing – Plastic Resins BSH Bosch und Siemens Hausgeräte GmbH]

A competitive materials' environment

Within the appliances industry PP (Polypropylene), ABS (Acrylonitrile Butadiene Styrene), and PS (Polystyrene) are the three main competing polymers, along with PA (Polyamide) 6 and 66 and PC (Polycarbonate) as part of the polymer mix. Every family of these polymers has a special role and value offering, but both PP resin and PP compounds are gaining market share in the inter-polymer competition. PP comprises a broad range of material grades and, over the past few decades, has grown to become the dominant polymer of choice for a wide variety of domestic appliances.

Major benefits offered by PP when replacing traditional materials

- High performance to cost ratio
- Low density resulting in lightweight products
- Higher productivity and energy savings
- Lower carbon and water footprint
- Excellent stiffness/impact balance
- Detergent resistance up to 95°C
- Good surface aesthetics
- Sound damping behaviour
- Low or no discolouration over time
- Good chemical and mechanical resistance



> **We appreciate the long-term commitment and strong co-operation we have with Borealis and we see them as a partner in driving innovative PP solutions into the market, resulting in high performance appliances.**
>
> [**Mirco Fantuz,** Purchasing Manager, Electrolux]

Focused on your success

Our contribution to your success lies in developing materials that enable innovation by increasing design freedom, optimising processes, improving end-use performance and aesthetics. And, do so faster, more efficiently, and with lower energy and resource consumption, than many alternative solutions. The following two examples serve to illustrate this.

Delivering long-term performance with excellent impact resistance

Fibremod GB364WG is a 30% chemically coupled short glass fibre reinforced PP compound that offers enhanced performance in tough in-service application components.

Typical applications

- High stress parts such as tubs in washing machines
- Functional parts including pumps and basements
- Housings

Key advantages

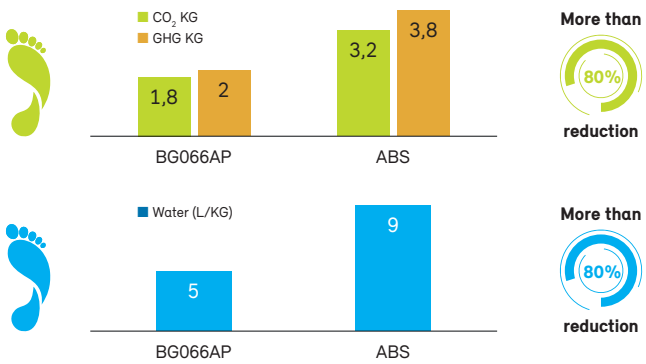
- Ideal for replacing stainless steel and polyamide (PA) parts with lower density therefore offering significant weight reduction
- Improved flexibility of design, assembly and welding compared to stainless steel, leading to fewer manufacturing steps
- Long-term performance with excellent stiffness, impact resistance, together with absence of corrosion
- Includes specifically designed detergent stabilisation
- Has excellent processability and offers a significant increase in productivity and energy savings
- Reduction of water consumption versus steel and offers easier recycling
- Benefits throughout the value chain, with long-term durability, no discolouration and both UL and food contact approvals
- No moisture absorption (compared to PA)

A revolutionary PP for aesthetical parts

BG066AP is one of the first PP resin grades to replace engineering plastics with high aesthetical demands (e.g. expensive ABS), at reduced cost level, high efficiency, high gloss and excellent scratch resistance.

Key benefits for the OEM - when replacing other engineering plastics

- Cost savings
- Weight saving due to low density
- Cycle time reduction, principally from faster cooling
- Good processability due to high flow and optimal polymer design
- Higher productivity or lower machine time at the same output
- Energy savings due to
  - Lower barrel temperature
  - Lower injection pressures
  - Lower mould temperature
  - Shorter cooling times
- Reduced carbon and water footprints



Typical applications

- Door frames and control panels for white goods
- Filter covers, hair dryers and vacuum cleaner frames
- Kettles, irons and other household and personal care products
- A variety of surface appearance parts for all types of appliances

> "Co-operating with Borealis gives us the opportunity of differentiating and further improving our products."
>
> [**Ogun Erdal,** Purchasing Manager – Polymers & Chemicals, Arcelik]

Solutions for appliances

Grade	Filler content [%]	MFR 230°C/2.16 kg [g/10 min]	Density [kg/m³]	Tensile modulus [MPa]	Charpy impact, notched 23°C [kJ/m²]	HDT B 0,45 MPa [°C]	Typical shrinkage [%]
Homopolymers							
BE50	n.r.	0.3	905	1,650	7	98	1.9
BE52	n.r.	0.25	900	1,300	8	98	1.9
HB600TF	n.r.	2	905	1,400	4	86	1.6
HB601WG	n.r.	2.2	900	1,400	5	85	1.4
HD120MO	n.r.	8	908	1,500	4	88	1-2
HD125MO	n.r.	12	908	1,550	3.5	88	1-2
HF700SA	n.r.	21	905	1,500	3.5	94	1.5
HG385MO	n.r.	25	910	1,750	3.5	115	1-2
Random copolymer							
RF365MO	n.r.	20	905	1,150	5.5	80	1-2
Heterophasic copolymers							
BC245MO	n.r.	3.5	905	1,350	15	90	1-2
BC250MO	n.r.	4	904	1,200	20	90	1-2
BC612WG	n.r.	5	900	1,100	9	70	1.5
Bormod™ BE961MO	n.r.	12	905	1,200	14	92	1-2
Bormod™ BF970MO	n.r.	20	905	1,500	8.5	105	1-2
BF335SA	n.r.	20	900	1,300	7.5	95	1.4
Borcom™ BG055AI	n.r.	22	920	2,000	3.5	108	1.5
BG066AP	n.r.	22	920	1,850	4	105	1.5
Borcom™ WG140AI	10	20	980	2,600	3.5	120	1.2
Mineral filled							
MD231U	20	6	1,050	2,900	3	125	1.1
ME212U	20	13	1,050	2,900	3	120	1.1
MB350WG	30	2.5	1,130	2,950	4.5	122	0.9
MB352WG	30	2.5	1,130	3,500	4	124	0.9
MB471WG	40	2	1,230	3,800	4.5	132	0.9
MD441U	40	6	1,220	4,200	2.4	132	0.9
Glass fibre reinforced							
Fibremod GB205U	20	2.2	1,040	4,800	10.5	154	0.2 / 1.1
Fibremod GB364WG/GB366WG	30	2	1,120	6,900	12	159	0.2 / 1.1

n.r.: not relevant

UL-listing	Key properties	Typical applications
•	High heat stabilised, good combination of stiffness and impact.	Injection moulded, blow moulded and extruded parts for white goods.
•	High heat stabilised, excellent balanced mechanical properties.	Injection moulded, blow moulded and extruded parts for white goods.
•	General purpose, good processability.	Extruded and thermoformed parts.
•	High heat stabilised, detergent resistant.	Injection moulded and blow moulded parts for white goods.
		Injection moulding general purpose.
		Injection moulding general purpose.
•	High heat stabilised, good antistatic performance, high gloss.	Parts for small appliances, like coffee machines.
•	General purpose, high stiffness.	Parts for small appliances.
•	Good transparency, good antistatic performance.	Transparent parts for small appliances, like level indicators.
	Good stiffness, impact strength and stress crack resistance.	Injection moulding general purpose.
	Very good processability, high melt stability, good stress crack resistance.	Injection moulding general purpose.
•	High heat stabilised, detergent resistant.	Parts for washing machines and dishwashers.
•	General purpose, very good impact. Borealis nucleation technology (BNT).	Parts for small appliances requiring good impact, such as housings.
•	General purpose, very good combination of stiffness and impact. BNT nucleated.	Parts for small appliances, like vacuum cleaners.
•	Good gloss and good antistatic performance and processability.	Parts for small appliances, like coffee machines and vacuum cleaners.
•	High heat stabilised, excellent gloss, high stiffness.	Parts with high aesthetical requirements.
•	Excellent gloss, excellent scratch resistance.	Parts with high aesthetical requirements and scratch resistance.
•	High heat stabilised, detergent resistant, good combination of stiffness and impact with low density.	Functional parts for small appliances and white goods, like washing machine tubs.
•	High heat stabilised.	Functional parts for small appliances and other technical parts.
•	High heat stabilised, good flow and processability.	Functional parts for small appliances and other technical parts.
•	Very high impact strength while maintaining good stiffness.	Injection moulded washing machine parts and dishwasher components.
	Excellent stiffness impact balance, excellent dimensional stability.	Injection moulded washing machine parts and dishwasher components.
•	High heat stabilised, detergent resistant.	Interior parts for washing machines, other technical parts.
•	High heat stabilised, good flow and processability.	Functional parts for small appliances, like housings, and other technical parts.
•	High heat stabilised.	Technical parts.
•	High heat stabilised, detergent resistant, good stiffness.	Functional parts for white goods, like washing machine tubs. Replacement of technical plastics, like PA.

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