INVESTIGATING THE ROTOMOULDING PROCESS

Special Project

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SCOPE OF THE PROJECT

What is ROTOMOULDING

Comparison chart of Rotomoulding Process with other Manufacturing Processes

Advantages and Disadvantages of Rotomoulding

Examples and Existing Applications in various areas

Exploration of various materials used in Rotomoulding Process

Advances in Rotomoulding Techniques

A tryout design

INTRODUCTION

Rotational moulding is one of the most versatile plastic manufacturing methods, much enhanced by the range of specialist polyethylene and polypropylene materials available. Rotational Moulding has the creativity, the productivity, the quality, the simplicity, the professional standards that is required in product design and production.

Simple in concept, rotational moulding is considered by those in the industry to be as much an art as a science in view of the importance of human judgement in the quality of the finished product.

THE ROTOMOULDING PROCESS

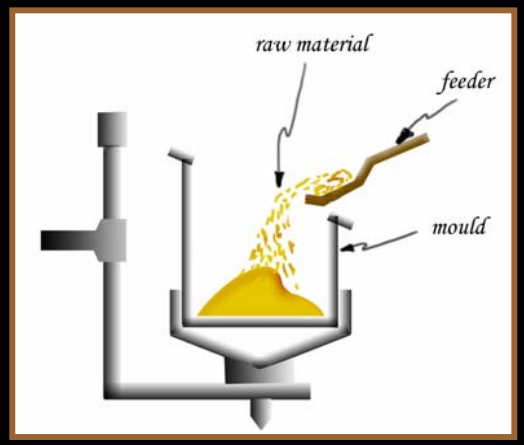
The rotational molding process starts with a good quality mould that is placed in a molding machine. It basically consists of 4 stages LOADING, HEATING, COOLING and UNLOADING THE MOULD.

Pre-measured plastic resin is loaded into each mould, and then the moulds are moved into the oven where they are slowly rotated on both the vertical and horizontal axis.

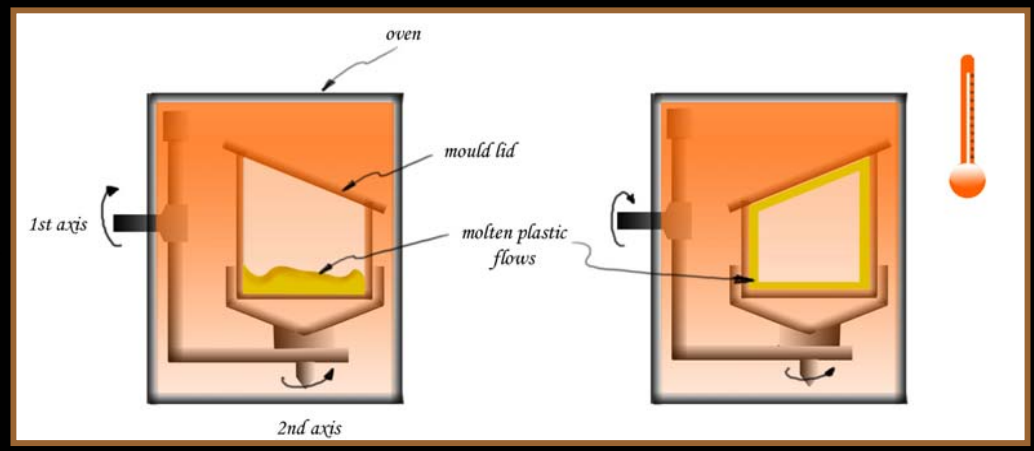
The melting resin sticks to the hot mould and coats every surface evenly. Once the parts are cooled, they are released from the mould.

THE PROCESS

The cycle is as shown in the figure below

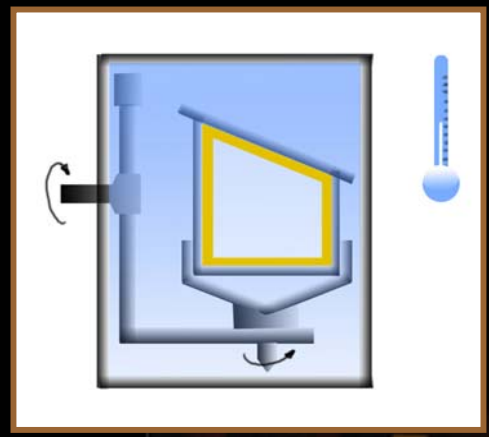


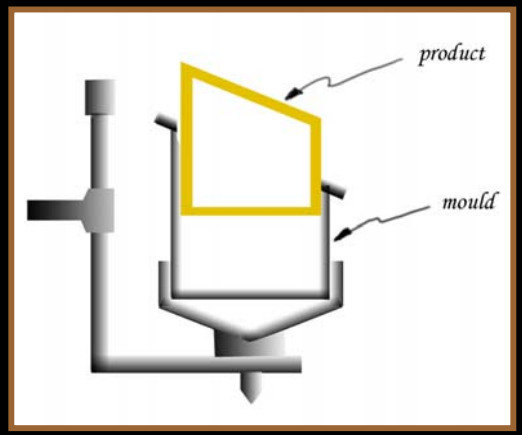
Loading



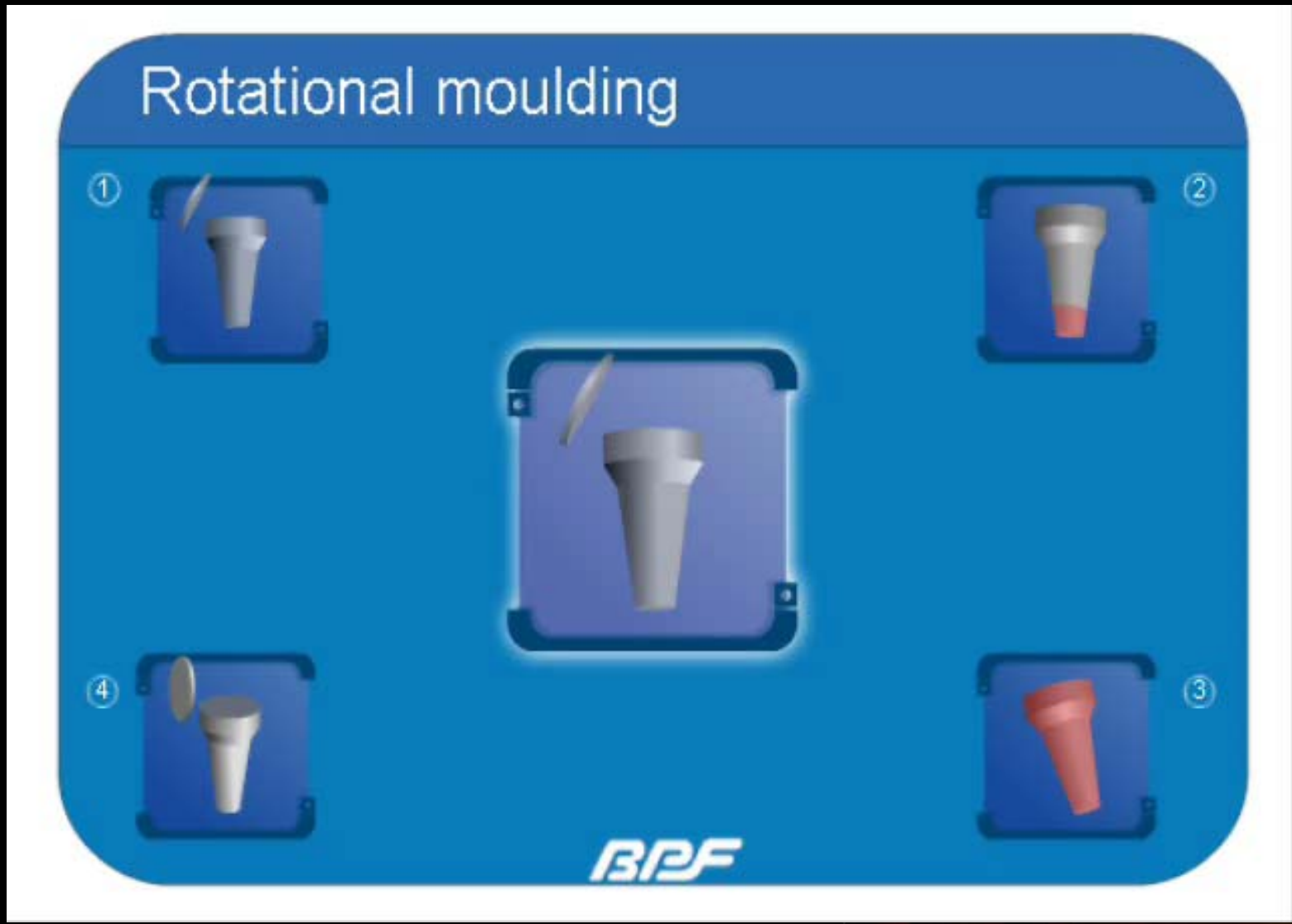
Heating

Cooling





Unloading


Rotational moulding
1
2
3
4
BPF

PROS AND CONS

ADVANTAGES:

1. Rotomoulding results in seamless parts with uniform wall thickness and more material in corners, to absorb shocks and stresses where they occur most.
2. The material isn't stressed during production (as in thermoforming or pressure forming) hence the finished part is stronger.
3. The moulds need not be engineered to withstand the high pressures as in case of injection moulding.
4. The mould has no internal core to manufacture hence the tooling costs are lower – and minor changes can be easily made to existing moulds as compared to injection and blow moulding.
5. Complex contours, metal inserts, flanges, and moulded-in threads can be designed into the walls.
6. The color can never crack or chip off, because it is moulded-in and hence no painting is required.
7. Ability to produce multi-wall mouldings, which can be left hollow or foam filled.

PROS AND CONS

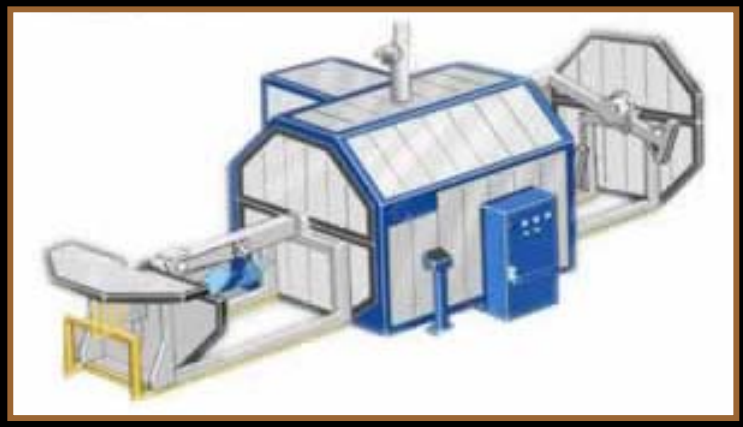
DISADVANTAGES

1. A disadvantage of rotational molding is the relatively long cycle times and hence production output.
2. Also very sharp contours or surface continuities cannot be maintained as it completely depends on the flowability of the material.
3. Some geometric features such as ribs used for strengthening in products,are difficult to mould.

COMPARISON

MANUFACTURING PROCESS	OPERATING PRESSURE	TOOLING COST	PIECE PRICES	PIECE SIZES	LABOUR COST	LEAD TIMES	PRODUCTION RATE	CYCLE TIMES	RAW MATERIALS
THERMOFORMING	*below or above atmospheric*	*low*	*vary depending on machinery*	*extremely large*	*high*	*6 to 8 weeks*	*high*	*from 1 min.*	*PVC(rigid and flexible), Polystyrene,Polypropylene, Polycarbonate,ABS, Polyester compounds*
EXTRUSION	*high*	*low*	*medium*	*medium*	*medium*	*3 to 5 weeks*	*high*	*n/a*	*BOPP(Biaxially oriented PP), CPP(Cast PP), LDPE, HDPE, PET, PC, Nylon, EVA(Ethylene Vinyl Acetate)*
BLOW MOULDING	*high*	*moderately expensive*	*higher than IM, less than RM*	*moderate*	*low*	*4 to 8 weeks*	*low*	*3 to 10 min.*	*ABS, Nylon, PC PPO(Poly Phenylene Oxide), ASA(Acrylate Styrene Acrylonitrile), PC-PBT(Poly Butylene terphthalate), PSO (Polysulphone)*
INJECTION MOULDING	*high*	*generally the highest*	*lowest available*	*very large*	*low*	*8 to 12 weeks*	*high*	*10 to 100 seconds*	*ABS, Nylon, PC, Polyethylenes,Polypropylenes, Polystyrenes,PVC*
ROTATIONAL MOULDING	*atmospheric*	*very low*	*high*	*small to large*	*low*	*3 to 5 weeks*	*moderate*	*40 to 45 min.*	*Rapid Roto 3604, Linear Medium Density PE, Borocene, LLDPE, PP, PVC Plastisols, LDPE, HDPE, PP, EVA, Nylon*
FIBRE REINFORCED PLASTIC (FRP)	*atmospheric*	*low*	*higher than plastic products*	*small to large*	*high*	*2 to 6 weeks*	*high*	*15 to 20 min.*	—

MACHINES



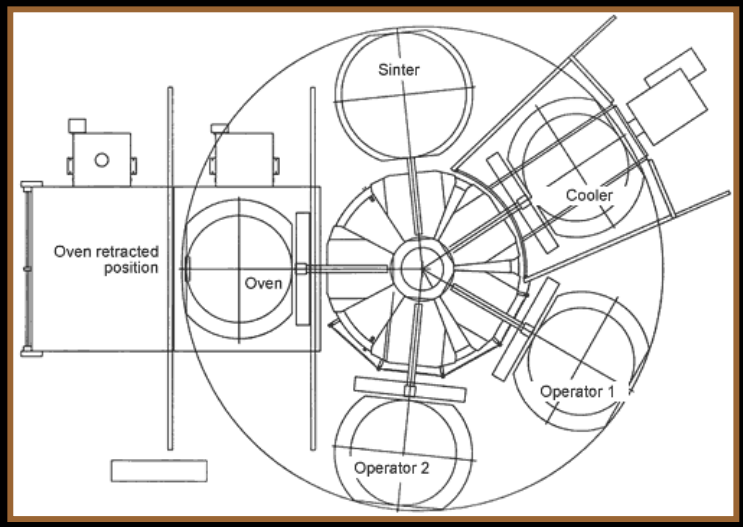
SHUTTLE MACHINES: SRM LINE

The shuttles are linear installations featuring a central oven and 1 or 2 carriages which are entered into the oven for cooking and then removed to a cooling station for cooling and extraction of the moulded parts

900 BOX

A small sized plant for rotational moulding used for the production of small items in large quantities (balls for games, and sports, dolls, toys, cones and road safety articles, fenders and buoy for boats, air mattress pumps, technical articles for cars, hygienic-sanitary ware and infant care).

MACHINES

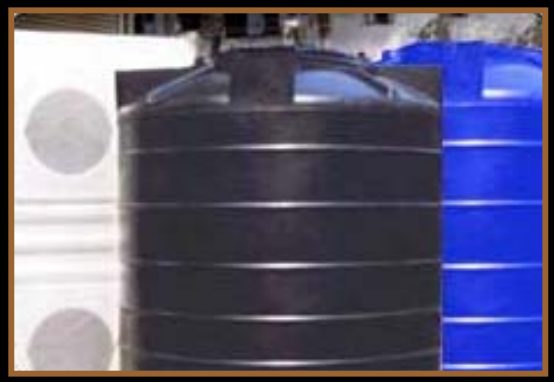


A plant with a central turret: maximum reliability and simplicity in use. An ideal machine for high volume production of articles, even of different sizes with similar working cycles.

CARROUSEL

APPLICATIONS

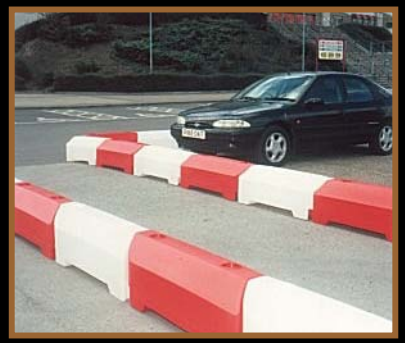
INDUSTRIAL & COMMERCIAL APPLICATIONS



Specialty tanks and containers for fuel, water, and chemical processing

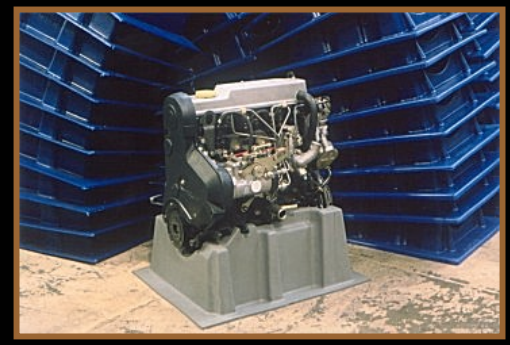
Drainage systems

Car Dashboards



Highway barriers and road markers

Industrial pellets



Engine Racks

APPLICATIONS

CONSUMER PRODUCTS APPLICATIONS

Rocking toys for kids

Rotomoulded chair

Double walled foam filled product

Double walled flasks

Litter box

APPLICATIONS

DEFENCE APPLICATIONS

Rotomoulded containers

Ammunition storage

Rotomoulded containers are used all over the world in extreme climatic conditions, including active combat, for such varied uses as transit of hot food, missile storage, rifle cases, foot lockers, engineering spares, 19 inch electronics racking and ammunition storage.

APPLICATIONS

TOY MANUFACTURING INDUSTRY

INNOVATIONS

Celliers Kruger has designed, built and is now exporting hundreds of plastic kayaks for "playboating" (freestyle stunts) and downriver tripping, effectively becoming the newest arrival in SA's innovative boat-building industry.

INNOVATIONS

Waterwall is a modular rainwater storage system for urban Australia. Holding approx. 1200 litres of water; and having only two thirds the depth of the average slim line tank.

AND interconnected Waterwall modules can be used as a fence or a dividing wall in the garden –

STORE WATER IN YOUR FENCE!

BASF Has Developed its First Polyamide for Rotomoulding Technology
Date: March 15,2005

BASF has developed its first polyamide for the rotomoulding technology. This un-reinforced polyamide 6 (PA6) is sold under the brand name **Capron BR30HS.**

The application includes **tanks for hydraulic oil or diesel fuel as well as coolant equalizing reservoirs**.

The inner surface of components made of the new Capron is very smooth, which is a prerequisite for liquid-carrying vessels. Capron is used in the automotive industry, the electric & electronics industry as well as all other sectors of industry such as furniture, packaging, sports and recreation.

RAPID ROTO 3604: ROTATIONAL MOLDING POWDER

Rapid Roto 3604 is a linear medium density polyethylene specifically designed for rotational applications. Rapid Roto 3604 has good flow, toughness, impact resistance and environmental stress crack resistance (ESCR).

SPECIAL GRADES:

- **Anti-Static**: Special formulations provide protection against dust pick-up and static generation.Find application in the food industry where hygiene is extremely essential.

- **UV Stabilised**: Special formulations are available for protection against harsh sunlight/ UV Light Find application in the outdoor articles in countries like India, Saudi Arabia, etc.

- **Custom Colours**: Powders can be manufactured in the other grades of L.D.P.E./ L.L.D.P.E./ H.D.P.E. and in different colors & fineness to suit individual requirements.

INNOVATIONS IN RAW MATERIALS

BORECENE:
Date: 2002

Borecene is a third generation linear medium density polyethylene designed for rotomoulding, developed by Borealis.

The property balance imparted through the novel metallocene catalyst system creates a combination of processing and product performance benefits for the moulder and the end user.

Borecene key strengths

- Improved mechanical properties
- Improved flow properties
- Less resin complexity
- Light weighting potential
- Better surface finish
- Less wall bubbles
- Better color consistency

Advantages

- Higher impact strength
- Improved process efficiency
- Simplified material handling
- Significant material savings
- Good looking products
- Optimal molding performance
- Brighter colors

INNOVATIONS IN RAW MATERIALS

Borecene is commonly used in applications such as Fuel tanks and the exterior body designing in the field of automotive.

Rotomoulded Fuel Tanks

Automotive Exterior

DESIGN ASSIGNMENT 1

DESIGN OF A CAR BUMPER (BMW):

Presently, the car bumpers are made from FRP (Fiber Reinforced Plastics) or SMC (Sheet molded compounds).

Due to the advances in the field of Rotomoulding it is quite possible to make the same bumper with rotomoulding process. The material best suited for the above application could be Borecene.

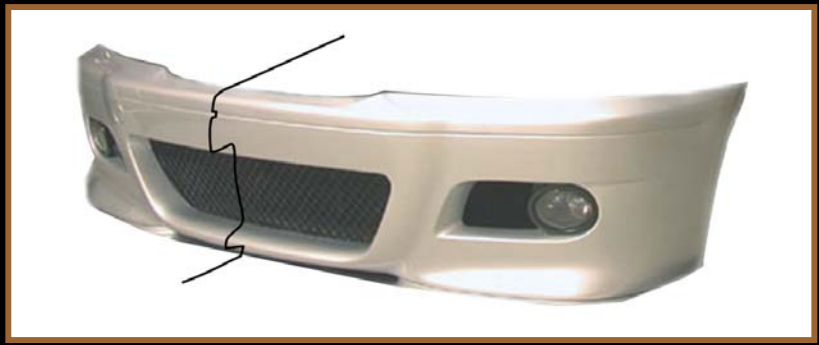
Borecene is selected due to its following properties,

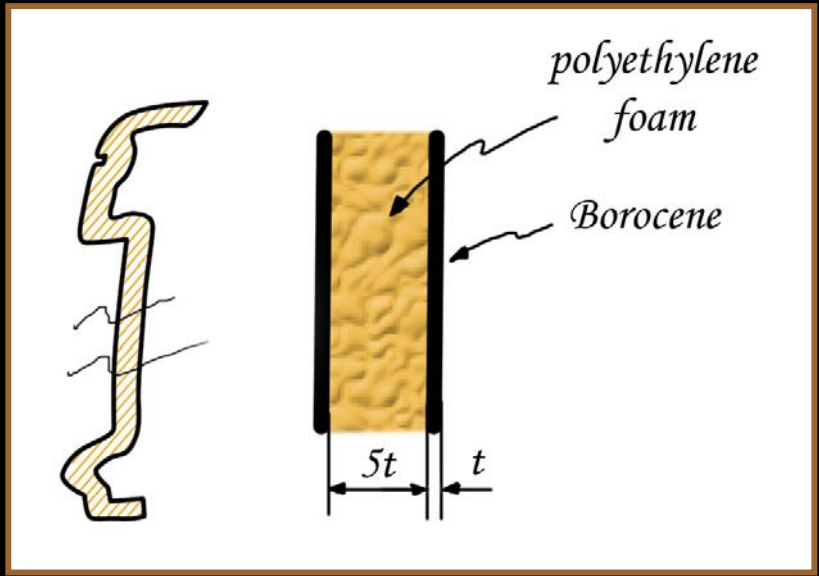
1. Higher impact strength and ESCR (Environmental Stress Cracking Resistance)
2. Improved mechanical properties.
3. Improved flow properties.
4. Better surface finish.

Bumper systems usually include a reinforcement bar plus energy-absorbing material, such as polypropylene foam. Better bumpers often have hydraulic shock absorbers instead of, or in addition to, the foam

DESIGN ASSIGNMENT 1

DESIGN OF A CAR BUMPER (BMW):





BMW FRONT BUMPER

For material to flow and form properly, it is recommended that the distance between the parallel walls be a minimum of 5 times the nominal wall thickness of the part.

DESIGN OF A SMALL REFRIGERATOR:

This assignment basically deals with the design of ‘A Small Refrigerator’ for applications in places such as 5-star Hotels, small restaurants and for applications where food has to be stored in small quantities.

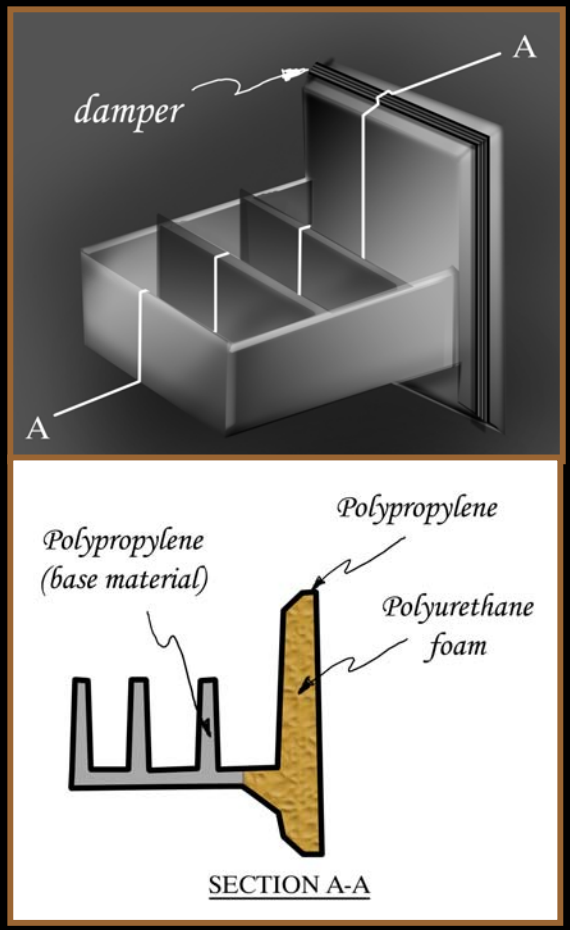
Since the size of the refrigerator is very small it becomes very easy to place it at any height level.

Polypropylene is selected as the basic raw material for this purpose mainly due to the following reasons:

1. PP is a Food grade plastic .hence the food can be stored safely.
2. Light in weight, and resistant to staining.
3. Has a low moisture absorption rate.
4. Can be easily fabricated.

DESIGN ASSIGNMENT 2

DESIGN OF A SMALL REFRIGERATOR:



SLIDING DOOR (SECTIONAL VIEW)

Height = 19''

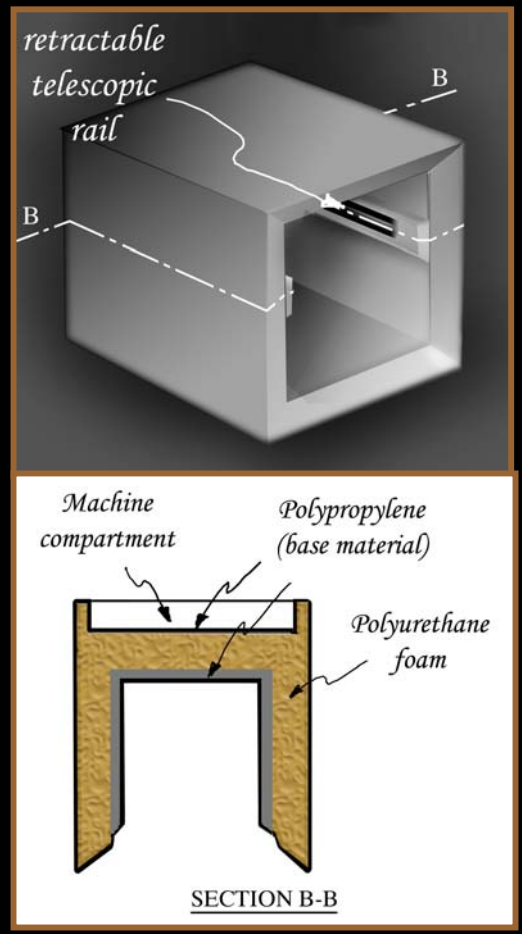
Width = 18''

Depth = 17''

Volume ~ 7 litres

Wall thickness = 4mm

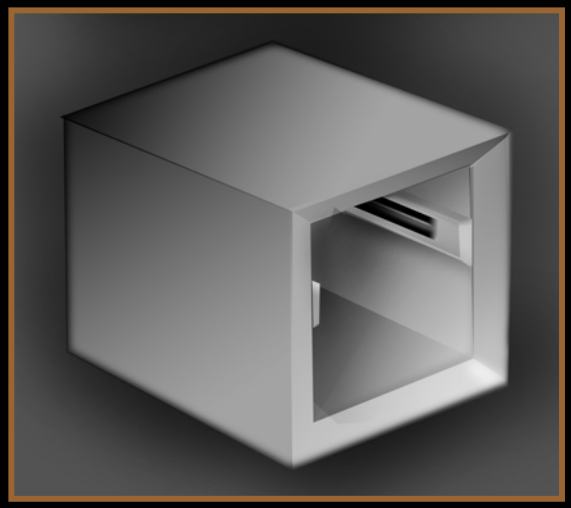
Foam thickness = 30 mm



REFRIGERATOR BODY (SECTIONAL VIEW)

DESIGN ASSIGNMENT 2

DESIGN OF A SMALL REFRIGERATOR:



Both the parts are made of polypropylene by the means of rotomoulding.They are manufactured in such a way that a part of the body gets filled entirely by the plastic wheras the remaining part acquires a ‘double walled’ structure.

This double wall actually helps in filling an insulation material such as polyurethane foam which helps in maintaining the contents of the fridge at the same temperature .