

ENERGY EFFICIENCY AND CARBON FOOTPRINT REDUCTION



MELT TO PREFORM

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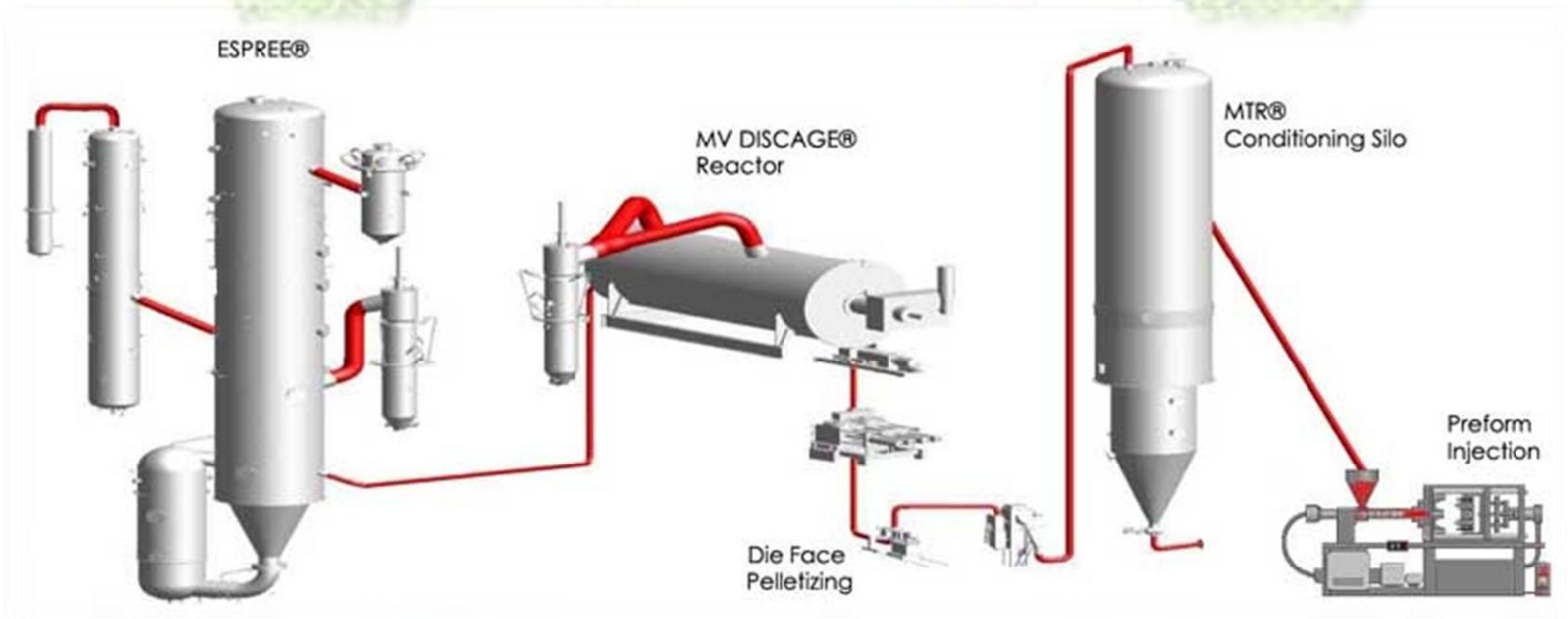
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PET RESIN PRODUCTION TECHNOLOGY

MELT TO RESIN (MTR)

- The high-viscosity MTR Technology completely replaces conventional solid-state post-condensation (SSP) for food and drink packaging.
- It is based on the established 2-Reactor technology.



- Up to 12% less energy consumption on preform injection process and also reduces oven energy requirement % 4 – 9 depending on the machine size and type for blow molding process.
- Lower dust in MTR resin compare to SSP Resin due to the spherical shape. MTR process generates lower than 100ppm dusts whereas SSP generates 500ppm.
- Environmentally, MTR technology requires less energy input and less carbon footprint comparing to SSP process.
- MTR resin has lower crystallinity. It can dry in lower temperature.
- Uniform IV distribution inside and outside of the resin pellets. It varies on SSP.



SUSTAINABLE FUTURE (MELT TO PREFORM)

This project was designed to transfer resin pellets from resin production reactor to the preform injection machines via special valves and blowers by the PLC controlled system.

The project is composed of two main parts;

- Hot Pet Chips Conveying System: Transportation of the hot PET Resin pellets (160° -180°) from just after main resin production reactor to the preform injection machines.
- Cold Pet Chips Conveying System: Transportation of the cold resin pellets from resin storage silos to the injection machine's dryer-bins.

HOT CHIPS CONVEYING SYSTEM BENEFITS

- Elimination of the COOLING process after reactor;
In a standard resin production process, Pet Resin Pellets are cooled down to 40° which is originally coming out of the reactor around 160°- 180° to prepare pellets for packaging.
- Elimination of the DRYING process in the injection machine;
In a standard pet injection process, pet is heated and dried before feeding to extruder. But since pet resin comes from resin production reactor in dried condition around 160- 180 ° C, no need for drying and heating process by direct feeding.
- Elimination of the cooling and drying process ensure better resin quality via preform quality, since every heating and cooling process of resin cause deterioration of the polyester structure.

HOT & COLD CHIPS CONVEYING SYSTEM BENEFITS

- Elimination of Packaging and Handling process;
In a standard pet resin production, resin pellets are packed in a PP (polypropylene) big bags after cooling process. Big bags has PE (polyethylene) nylon layer inside to prevent any contamination and secure humidity. Big bags generally transport with wooden pallets. Moreover there is no footprint and residual waste due to the elimination of packaging process.
- Internal transportation of the resin is eliminated in the warehouse. No forklift or heavy load vehicle is required since they are all conveyed through conveying pipes.
- Decrease warehouse space requirement.
- Eliminating contamination of the pet resin pellets from foreign objects which could generate during packaging, transportation, storage and feeding process.

“GREEN WORLD”

ENERGY SAVING AND CARBON FOOTPRINT REDUCTION

PRODUCTION CAPACITY

- Köksan’s Pet Prefrom production capacity; 110 000 ton/year
- Because of two different viscosity for the resin needed for daily production, we assume that we can transport half of the yearly production (55 000 ton/year) with hot transport and the other half with cold transport.

DETERMINING CARBON EMISSION DUE TO THE ELECTRICITY CONSUMPTION IN TURKEY

- Carbon emission calculation for electricity generation;

Carbon Emission = Electricity Consumption x Emission Coefficient

- The carbon intensity is the determining factor for the CO₂ emissions from electricity generation. Most of the CO₂ emissions caused from thermal power plants, and there is no CO₂ emission on the renewable energy sources such as wind power, hydro etc.

Therefore, changes in electricity generation system has significant effects on the emission.

- The emission coefficient from electricity generation in Turkey calculated as 0.5459 kgCO₂/kWh due to the UNFCCC's latest methodology

HOT CHIPS CONVEYING SYSTEM CO₂ SAVING

- Energy for Cooling Process ; Pet resin is cooled down to 40 °C from 170 °C

$$Q = m \times C_p \times \Delta T$$

= 1 kg x 1,5 kJ/kg⁰C x (170-40) °C = 195 kJ x 1000 / 3600 = 54,17 kWh for each tones of PET

- Energy for Drying Process; Pet resin is heated to 170 °C from 22 °C

Q = 1 kg x 1,5 kJ/kg⁰C x (170-22) °C = 222 kJ x 1000 / 3600 = 61,67 kWh for each tones of PET

- Yearly energy gain;

$$(54,17 + 61,67) \text{ kWh} \times 55.000 = 6\,370\,000 \text{ kWh}$$

- Total CO₂ emission; 6 370 000 x 0,5459 = **3 477 ton CO₂**

HOT & COLD CHIPS CONVEYING SYSTEM CO₂ SAVING

- The average energy required to make 1 kg of plastic is 20 kWh

- Polypropylene big bag

Per 1 100 kg pet resin; 1,67 kg PP big bag is saved

110 000 ton / 1,1 ton x 1,67 kg = 167 000 kg = 167 ton PP per year

- Polyethylene nylon

Per 1 100 kg pet resin; 0,67 kg PE nylon used

110 000 ton / 1,1 ton x 0,67 kg = 67 000 kg = 67 ton PE per year

- Yearly energy save for plastic production;
(167 ton + 67) x 20 000 kWh = 4 680 000 kWh

- CO₂ emission due to plastic production;
4 680 000 kWh x 0,5459 = **2 555 ton CO₂**

- Fuel consumption

For each 1 100 kg pet resin, forklift works 235 seconds to carry the big bags from resin production reactor to storage area and works 355 seconds to feeding of injection machines from storage area.

$$(235 + 355 \text{ sec}) \times 110\,000 \text{ ton} / 1,1 \text{ ton} = 59\,000\,000 \text{ sec} / 3600 = 16\,389 \text{ h per year}$$

- Inside the preform production area we use electrical forklift, on the outside, for carrying and feeding the pet resin, LPG-powered forklift is preferred. Fuel consumption of LPG forklift is 1,6 kg/h

- In the Turkey; LPG is produced with % 30 propane and % 70 butane, and the density is 550 kg/m³

$$16\,389 \text{ h} \times 1,6 \text{ kg/h} = 26\,222 \text{ kg LPG} / 0,55 = 47\,676 \text{ lt per year}$$

- LPG equivalent CO₂ factor as a fuel is 1,502252 kg CO₂/lt

$$47\,676 \text{ lt LPG/year} \times 1,502252 \text{ kg CO}_2/\text{lt} / 1000 = \mathbf{71,6 \text{ ton CO}_2}$$

- Wooden pallets

Per 1 100 kg pet resin; 1 wooden pallet used. And each pallet can be used 3 times.

$110\ 000\ \text{ton} / 1,1\ \text{ton} / 3 = 33\ 330\ \text{pallets per year}$

- CO₂ emission for 1 kg of wooden pallet production is 14,94 kg;

$33\ 330 \times 14,94 = \mathbf{0,49\ \text{ton CO}_2}$

SUMMARY

- This project ensures to decrease energy consumptions for preform manufacturing processes. In addition, by securing the contamination issues and prevention humidity of the pellets provide higher purity and product quality for an end user.
- With this project, annual CO₂ emission saving is 6 104 ton;
 - 1 hectare of forest can absorb 6 ton/year CO₂. We save **1 017** hectare of forest
 - In Turkey, CO₂ emission per capita is 5,9. We save **1 034** people's emission
- Total energy saving 11 050 000 kWh/year
In Turkey, due to Electricity Generation Company, electricity consumption per capita is 2 577 kWh/year. Our electricity gain with this project is the amount of energy consumption of **4 288** people.

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