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WELCOME TO
IMG PLASTEC

IMG Plastec Group supplies:
(i) EPP/E-TPU foam beads production system and
(ii) its complete know-how and technology.

IMG PLASTEC
MACHINERY & PLANT ENGINEERING GROUP

Turn-key Solution for EPP, E-TPU Beads Production Plant
(Autoclave Technology)

IMG PLASTEC
MACHINERY & PLANT ENGINEERING GROUP

Korea | China | Poland | Russia | USA

'Group of experts in the production of particle foams over 30 years'

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IMG PLASTEC

" We are IMG Plastec, a global group.
We promise to do our best for clients. "

Young G. Song / CEO
IMG Plastec Co., Ltd.

Who we are:

The IMG Plastec Group started off as a beads foam production processing machinery and plant engineering company. Gradually, IMG Plastec developed to the core of an innovative and constantly expanding enterprise group. Today, the IMG Plastec Group supplies in two segments which are EPP and E-TPU foam beads production system and its complete know-how and technology.

What we are doing:

In the future, most of steam chest molders will install EPP bead foam autoclaves directly in the plant and produce EPP beads by themselves, such as EPS bead foam production which will significantly reduce the price of EPP material and shipping cost.

Numerous EPP applications have been developed in various industries due to the lowered price of EPP and its outstanding performance in energy absorption, resilience, chemical resistance, rigidity, durability, thermal insulation properties, acoustic properties, fracture strength, recyclability, sustainability, and so on.

What is EPP?

EPP, also referred to as EPP bead or EPP foam, stands for Expanded Polypropylene foam bead. EPP bead is used in a wide variety of applications for packaging, buoyancy, insulation, protection, and so on. As product coverage increases in automotive, consumer goods, construction, packaging, sporting goods, toys and household goods, the reduction in material cost is expected to have a significant impact on the overall market growth in the coming years.

The Future of Particle Foam!

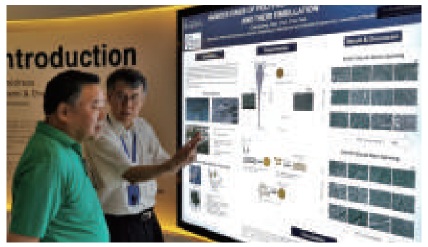
IMG Group CEO Young G. Song & Prof. Chul B. Park (CTO) Diagnosis

Q. Song: The price of polypropylene (PP), the base material of EPP, is about 20–30% lower than that of polystyrene (PS), the base material of EPS. However, comparing the prices of EPS and EPP foam beads, the opposite is true. The price of EPP beads is about twice as high as that of EPS. Why is that?

A. Park: EPS pellets with impregnated pentane are produced directly from the pre-expander. EPS producers buy EPS pellets and use steam in a pre-expander to foam them. However, EPP (and E-TPU) is different. First, EPP (and E-TPU) mini-pellets of about 1 mg are made through the extrusion process, and then the mini-pellets are placed in a high-temperature and high-pressure autoclave, to be impregnated with CO_2, and to be expanded 5 to 30 times. A higher expansion ratio over 30-70 times, or even higher, can be obtained by using the steam pressure in the secondary foaming machine. On the other hand, PP has a sudden drop in viscosity when heated, and it is very difficult to form foam walls. Therefore, expensive manufacturing facilities with very precise and professional control systems for making two peak crystals in PP are required. But these complicated processing technologies cannot justify the 2-fold EPP price over the EPS price. The EPP's high price basically came from the patent rights and the high cost for transportation of the expanded EPP beads. Until recently, global companies such as JSP, Kaneka, BASF, Hanwha, and Lotte had been exclusive suppliers, using the earlier patents around the world. But the patent has been expired, the steam-chest molding companies do not have to pay twice the EPS price. The EPP cost will be significantly reduced if the molding companies make their own EPP foam beads to avoid the patent royalty and the unnecessary transportation costs.

Q. Song: The main raw materials for synthetic resins in foamed plastics are polyurethane (PUR), PS, polyolefin and thermoplastic polyurethane (TPU). In addition, there are foam products such as extruded PS (XPS), PS paper (PSP), and crosslinked polyethylene (XLPE) foams that are made by the extrusion method. Also, there are foamed beads, such as EPP and E-TPU, which are blown by using supercritical CO2 in a high-pressure autoclave. How do you predict the future development potential of bead foams using an autoclave?

A. Park: First of all, I would like to clarify that the bead foam technology is the ONLY method that people can use to make low-density foams with complicated 3-D geometry. Foam beads can be inexpensively made, either by the autoclave technology, or by the extrusion technology. The autoclave technology is very versatile and capable of independent control of the required properties of the EPP and E-TPU foam beads. The autoclave equipment is not that expensive, either. The required two peaks of EPP will not be easily created using extrusion foaming technology. For E-TPU, the quality of E-TPU foam beads made from the extrusion technology may not be as good as that of E-TPU foam beads made from the autoclave technology. Therefore, I believe that the autoclave-based foam bead manufacturing technology is very promising for the future.



Q. Song: You emphasized that all semi-crystalline polymers can be made into bead foam having double peak. In what direction do you think new materials that will receive attention will evolve in the future? Also, please tell us about the development of a new material that combines the advantages of EPP and E-TPU by adding nanofiber rubber to EPP.

A. Park: Because of the outstanding performance and the low cost of EPP, the EPP market will grow steadily with continuous development of various new applications requiring a wide range of different mechanical properties: (i) from very soft foam applications with high ductility (i.e., high elongation at break, high toughness and high impact strength), while sacrificing the stiffness, (ii) to very rigid foam applications with high stiffness while sacrificing the ductility (i.e., low elongation at break, low toughness and low impact strength). We could not achieve both high stiffness and high ductility at the same time using conventional materials. Normally, increased ductility will be accompanied by a major sacrifice of the stiffness. However, the new nanofibril rubber technology will enable us to achieve the ductility without sacrificing the stiffness.

Paradigm Shift of EPP Production System

"In the future, the EPP foam beads can be manufactured by the user (molder) to greatly reduce the EPP material cost, instead of depending on the monopolistic companies' tight operation. The autoclave-based EPP equipment will be supplied at a very low price, and the optimal foam processing conditions will be supplied free of charge, by applying artificial intelligence AI to the recently digitized plant, so that EPP foam beads can be produced easily and stably." Chul B. Park, Ph.D.

"Dream team leading paradigm change in particle foam production using Autoclave technology."

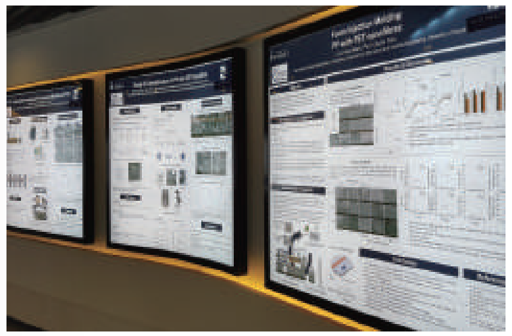
[CEO Young G. Song & CTO Chul B. Park]

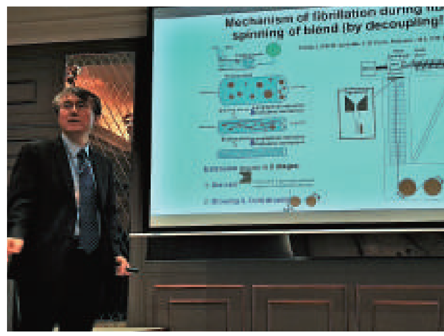
"In other words, the new nanofibril rubber technology will increase the range of new applications requiring both high stiffness and high ductility. Another advantage, especially for automotive applications, is decreased density with the same functions. A lower density rigid EPP foam having a small nanofibril rubber content will be able to exhibit the same properties as the higher density soft EPP foam and, thereby, we will be able to decrease the weight of the EPP products."

"**All semi-crystalline polymers can be made into bead foams having double peak with tailored properties.** By producing such foam beads directly from the molding company, innovation can be easily brought to (i) the market development for new applications, (ii) the product development with desired properties, and (iii) the processing technology improvement for reduced costs, enhanced quality, enhanced sustainability, and enhanced safety." Chul B. Park, Ph.D.

CEO & Chairman Young G. Song has been researching and developing equipment-manufacturing and molding technologies for polymer foams over 30 years. He is currently distributing autoclave-based bead foam production technologies and facilities. In particular, he is supporting bead-foam producers, together with experienced professors and professional technicians in the foam field, to safely and cost-effectively manufacture EPP and E-TPU foam beads, while supplying a compact smart factory system that incorporates artificial intelligence, and state-of-the-art equipment.

CTO Chul B. Park, Ph.D., P.Eng. received his Ph.D. from MIT in 1993. He is Distinguished Professor of Microcellular Engineered Plastics at University of Toronto. He serves as a consultant and the CTO of IMG Plastec. Prof Park was a major inventor of MuCell Technology and has identified the fundamental mechanisms of cell nucleation and expansion. Especially, he elucidated for the first time the roles of the EPP bead's two crystal peaks in foaming. He has published more than 1400 papers, including 420 journal papers and 4 books, with the h-index of 76. Prof. Park also serves as the Editor-in Chief of Journal of Cellular Plastics and sits on the Advisory Editorial Board of 12 other international journals.



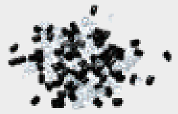


How to produce EPP Beads and products?

The production of EPP products goes through three processes:

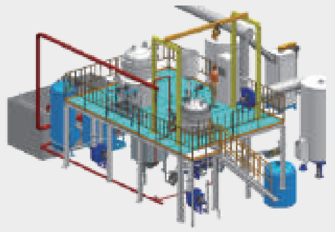
1st mini-pellet production, 2nd EPP bead expansion, and 3rd EPP molding process.

1st
Extrusion



> Mini-Pellet

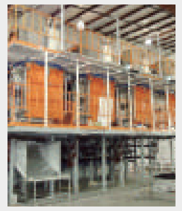
2nd
Autoclave Reactor system



> Beads Expansion

3rd
EPP Molding System

> Pressurizing



> EPP Shape Molding

The first step in EPP production is to produce mini-pellets through an extrusion process. In this process, important additives are added to create mini-pellets with a weight of ~1 mg.

In the second process, water, additives, and mini-pellets are put into an autoclave, heated to the melting temperature of PP. Then, CO_2 gas is injected to impregnate the mini-pellets under pressure. Finally, the CO_2-saturated mini-pellets are released to produce EPP beads with the desired expansion ratio.

The third process is to put the EPP beads in a pressure tank and pressurize for about 8 hours to restore the shrunken beads, and then inject them into the mold of the steam chest foaming machine to make the desired shape of the product.

1.PP Mini-Pellet Production
(Extrusion)

- Dosing(R-PP+M/B, Additive)
- Extrusion
- Strand Formation
- Water Cooling
- Pelletizing
- Dryer & Sieving Unit
- Storage

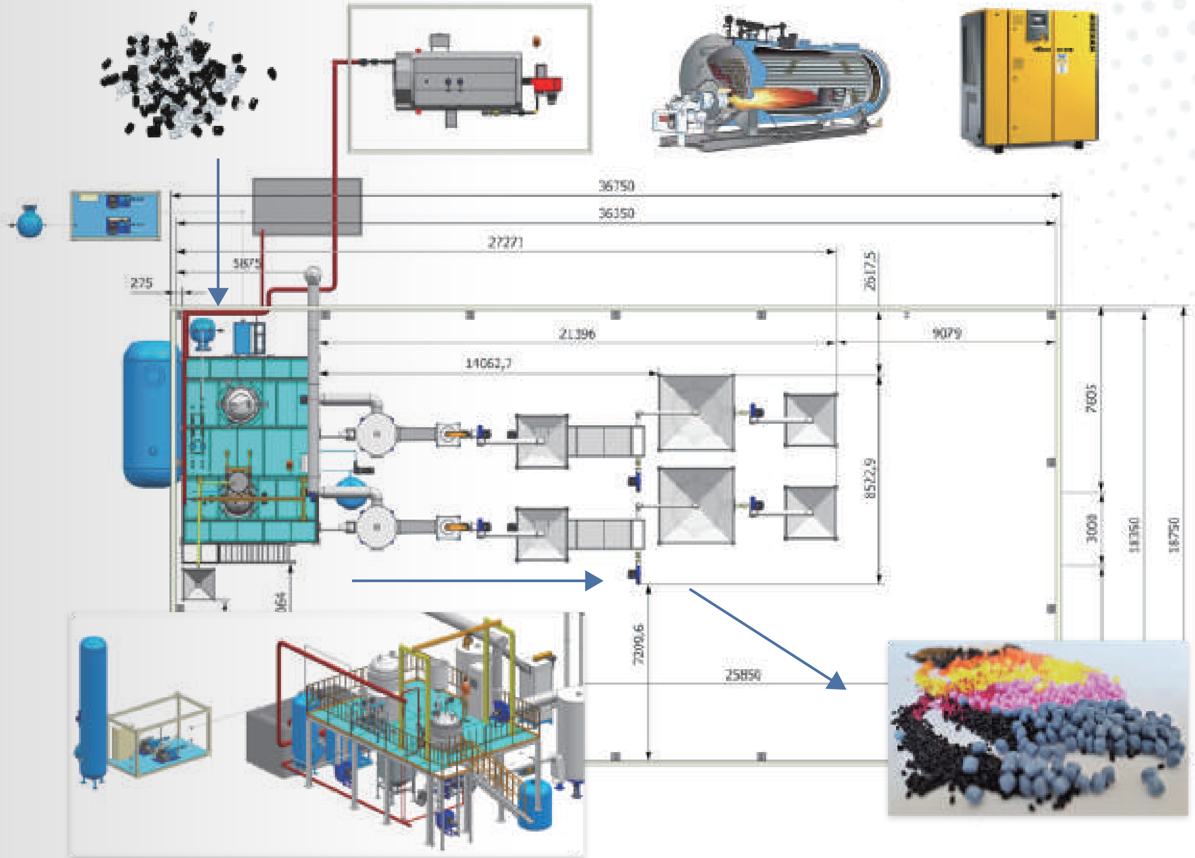
2. EPP Bead Expansion
(Autoclave Reactor)

- Weighing Material
- Temperature, Pressure Up
- Expansion Beads
- Washing & Drying
- Density Checking
- 2nd Expansion
- Silo Storage

3.EPP Shape Molding
(Shape Molding)

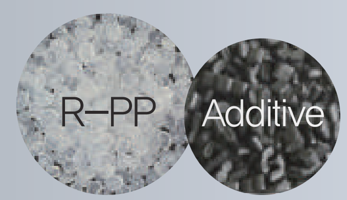
- Pre-Pressurizing
- Shape Molding
- Drying
- Storage

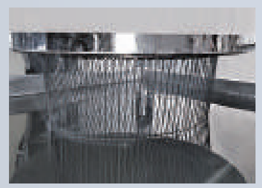
EPP Bead Plant Layout



PP Mini–Pellet Production Line

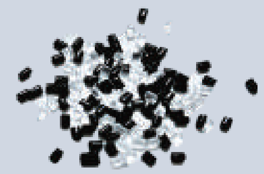
To make low-density EPP beads with an expansion ratio of 5 to 70 times, you need to first make mini-pellets of consistent size ~1 mg through the extrusion process.



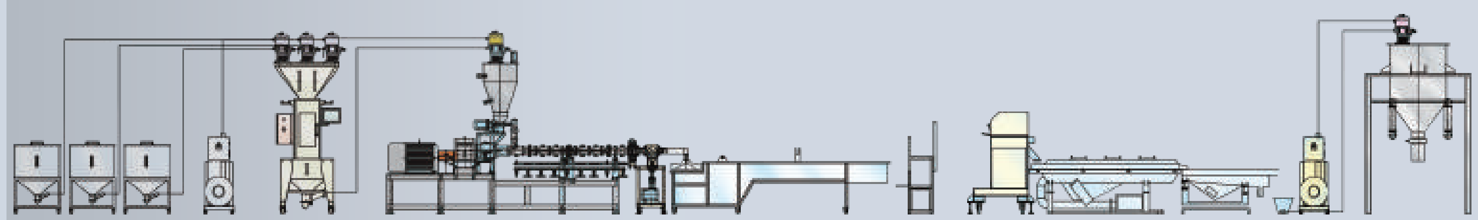


Die Head

Pelletizer

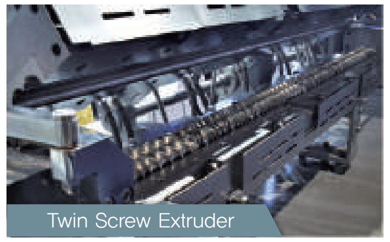


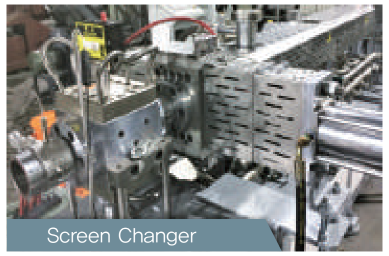
Mini-Pellet (~1 mg)



Mini-Pellet Production Line

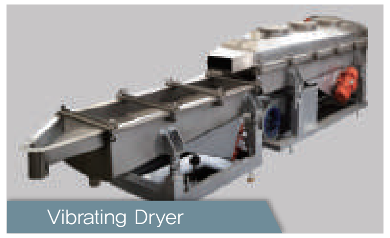

Gravimetric Blender


Twin Screw Extruder


Screen Changer


Cooling Bath

Pelletizer


Vibrating Dryer

The first step in the manufacturing of EPP is the production of mini-pellets through an extrusion compounding process. We can use a single-screw extruder in some cases, but a twin-screw extruder is typically used for most applications for compounding. The main ingredient of mini-pellets is random copolymer polypropylene (R-PP). Special additives are compounded into R-PP in the compounding extruder. The additives include color master batch, cell enhancer, antistatic agent, nucleating agent, etc., and the amount is determined and mixed in an automatic gravimetric blender.

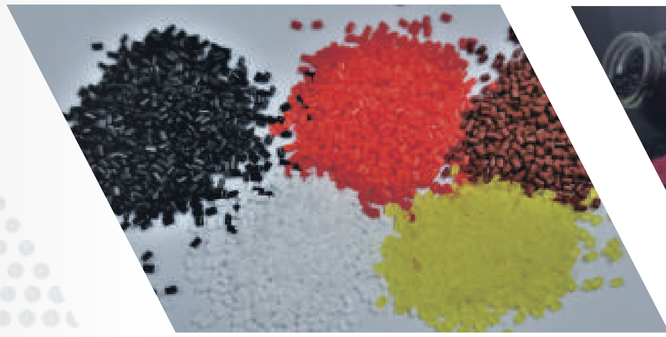
Mini–Pellet Extrusion Line (IM–EXS100)

The blended materials are pelletized accurately to the desired size of ~1 mg.

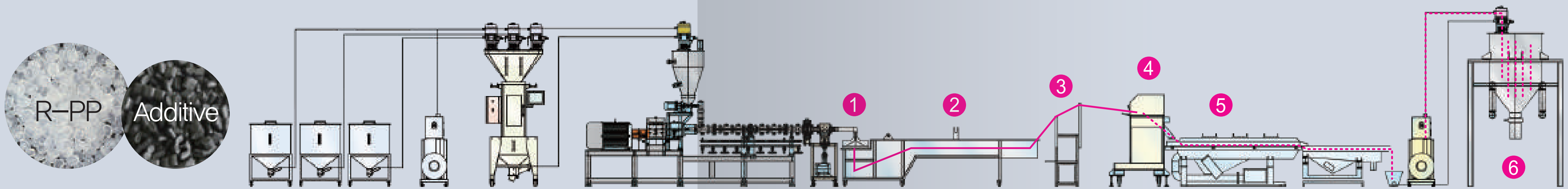
The most critical thing in the production of mini-pellets is the know-how of the extrusion technology that includes special additives, the die head and the pelletizer to precisely and consistently cut the beads to the desired size.

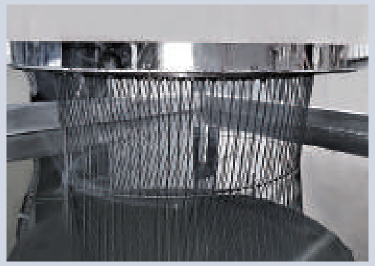
Function of the Downstream Systems

Polymer strands extruded from a die head ① pass through the cooling trough ②. The air knife ③ ensures effective drying of strands prior to cutting. The residual moisture evaporates in the evaporation section. The feed tools of the strand pelletizer ④ catch the polymer strands and direct them to the cutting tools where the strands are cut into pellets. The pellets are classified, cooled, and conveyed in subsequent operations ⑤. The cut and dried mini-pellets are transported to the storage silo by air blower and packed ⑥.



*Out put: Approx. 200 kg to 300 kg/hr




Die Head (100 lines)


Cooling Bath

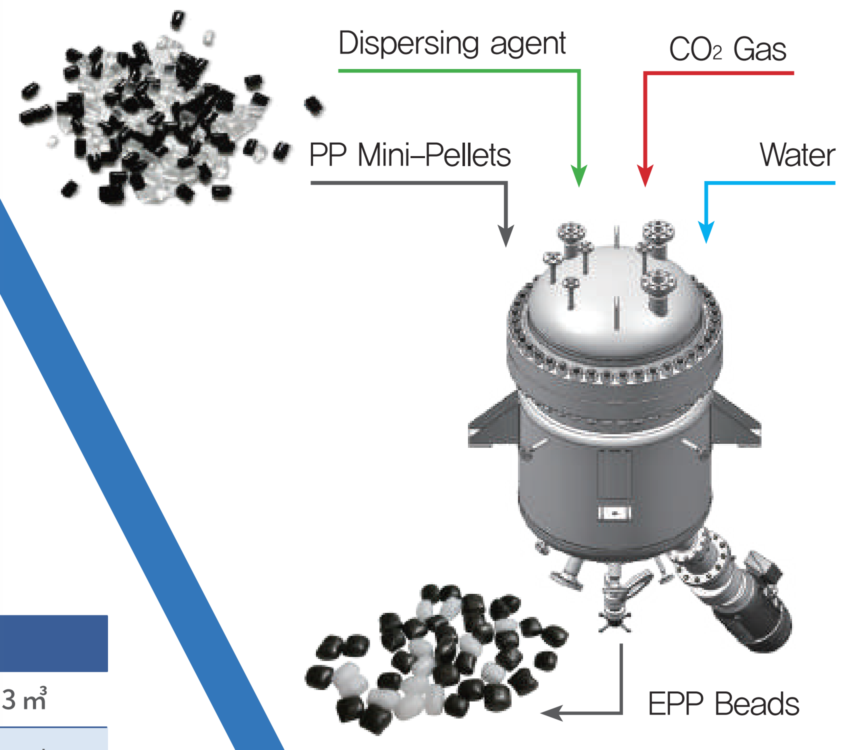

Mini-Pellet Pelletizer

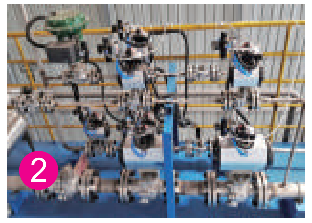

Dryer & Sieving Unit

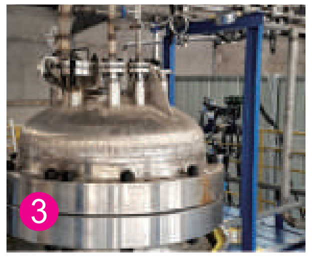

Mini-Pellet Weighing Roughly ~1 mg

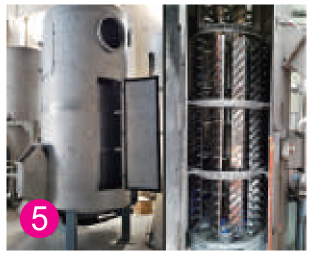
EPP Beads Expansion System

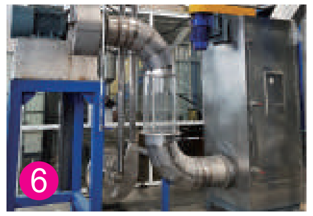
First, EPP (or E-TPU) mini-pellets of about 1 mg are made from the extrusion process, then the mini-pellets are placed in an autoclave at high temperature and high pressure to be impregnated with CO_2 and expanded 5 to 30 times. A higher expansion ratio over 30-70 times, or even higher, can be obtained by using the steam pressure in the secondary foaming machine. On the other hand, PP has a very low melt strength, and it is very difficult to form cell walls. Therefore, expensive manufacturing facilities with very precise and professional control systems for making two-peak crystals in PP are required.

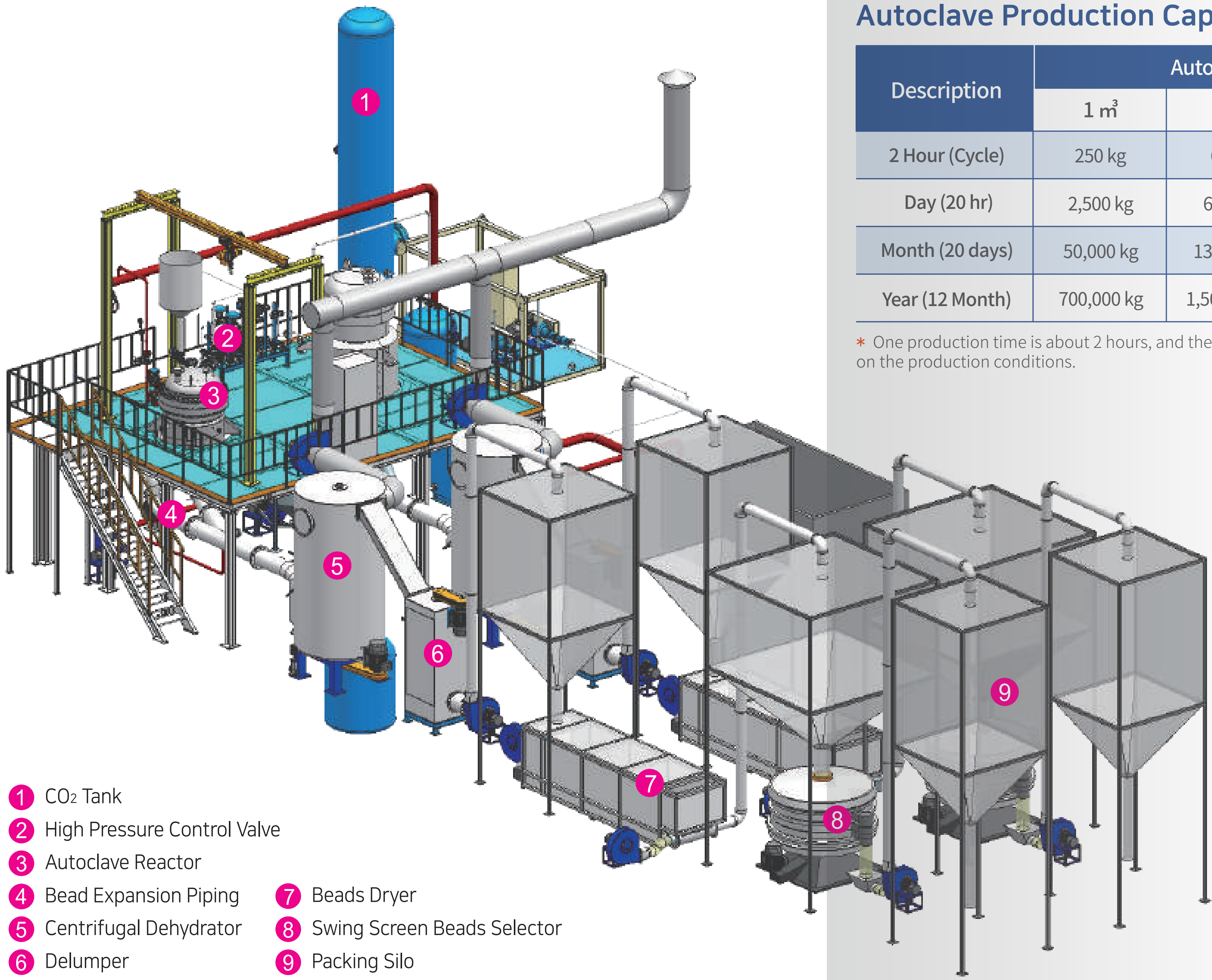












1. CO_2 Tank
2. High Pressure Control Valve
3. Autoclave Reactor
4. Bead Expansion Piping
5. Centrifugal Dehydrator
6. Delumper
7. Beads Dryer
8. Swing Screen Beads Selector
9. Packing Silo

Autoclave Production Capacity

Description	Autoclave Size		
	1 m³	2 m³	3 m³
2 Hour (Cycle)	250 kg	650 kg	1,000 kg
Day (20 hr)	2,500 kg	6,500 kg	10,000 kg
Month (20 days)	50,000 kg	130,000 kg	200,000 kg
Year (12 Month)	700,000 kg	1,500,000 kg	2,400,000 kg

* One production time is about 2 hours, and the total output varies depending on the production conditions.

Mini-Pellets

Expanded Beads (EPP)

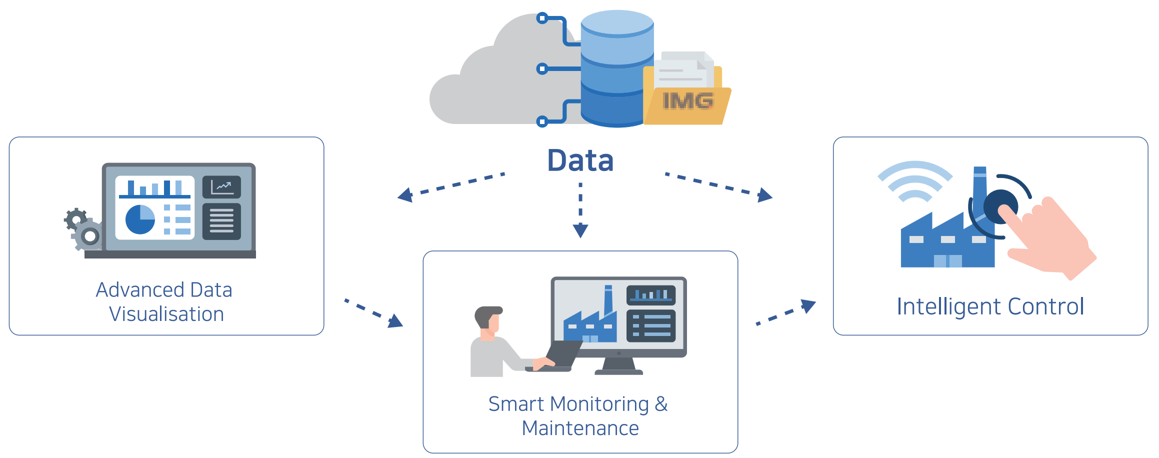
Typically, two units of autoclaves are installed: one to make the main products and another to make small quantity products or spare parts. More units can be installed as needed. Conventional manufacturing process of EPP beads is a batch foaming process in which solid R-PP mini-pellets are impregnated with CO_2 blowing agent for about 1 hour.

Digitalization EPP Plant

IMG provides a turn-key smart factory that provides optimal foam processing conditions to stably and cost-effectively produce EPP foam beads by applying artificial intelligence (AI) to the recently digitized factory in our autoclave-based EPP equipment.

Digitalization is noticeably changing our world – and the world of industry. Enormous data volumes must be managed and archived for a long term. At the same time, production processes must be monitored and controlled in a reliable, efficient, and productive way to be constantly optimized for any variations in the required properties or any noise factors in the materials and the environment.

Network System

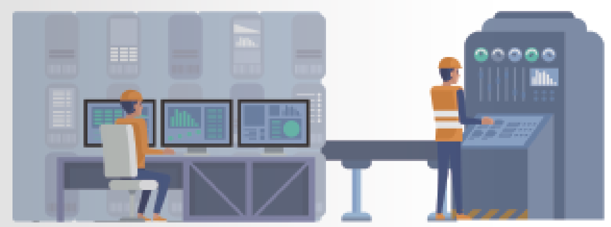


We offer an on-line control service by integrating all the IMG machines and factories into the IMG network so that errors can be found and corrected immediately using on-line network.

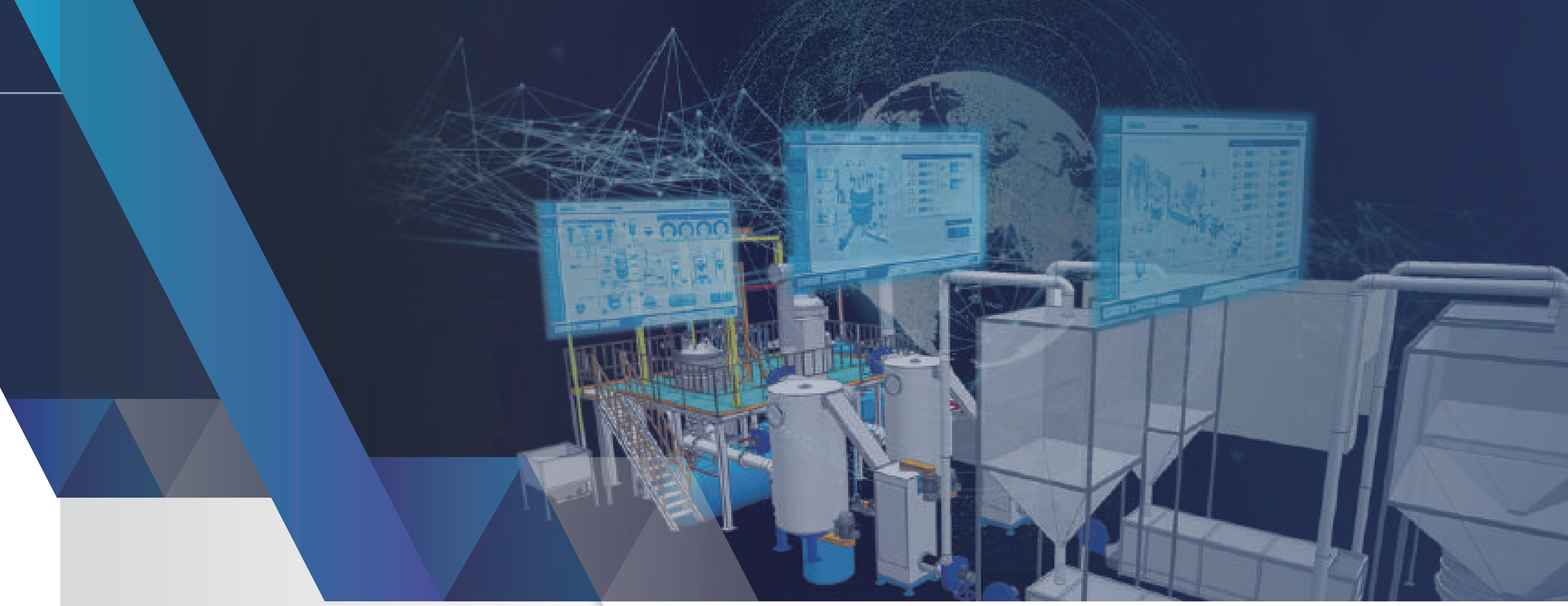
SCADA System

SCADA typically consists of a combination of software and hardware such as PLCs and RTUs. Data are collected from PLCs and RTUs that communicate with plant floor equipment such as factory machines & sensors. The data collected from the equipment are transferred to the next level, such as the control room, and the operator can supervise PLC and RTU control by using HMI. The HMI is a screen which is a major element of the SCADA system to support communication between the operator and the system.

Factory Control

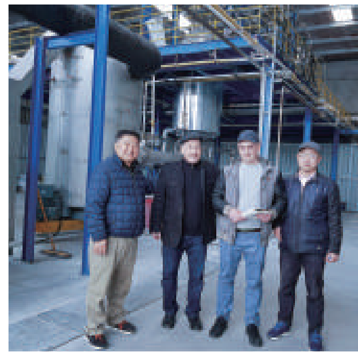


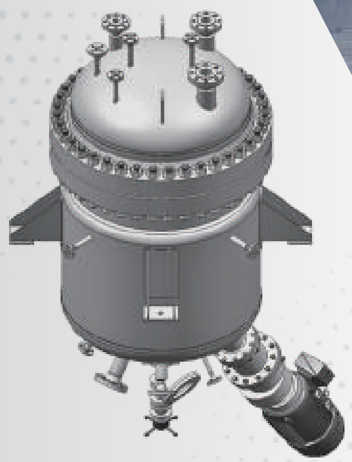
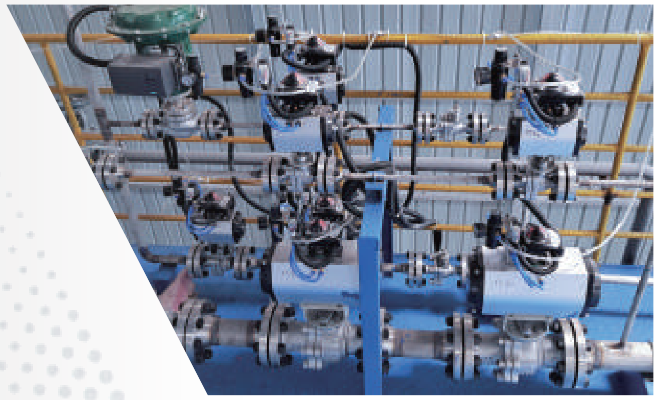
Installation Case



In the future, the EPP foam beads can be manufactured by the user (molder) to greatly reduce the EPP material cost, instead of depending on the monopolistic companies' tight operation. The autoclave-based EPP equipment will be supplied at a very low price, and the optimal foam processing conditions will be supplied free of charge, by applying artificial intelligence (AI) to the recently digitized plant, so that EPP foam beads can be produced easily and stably.



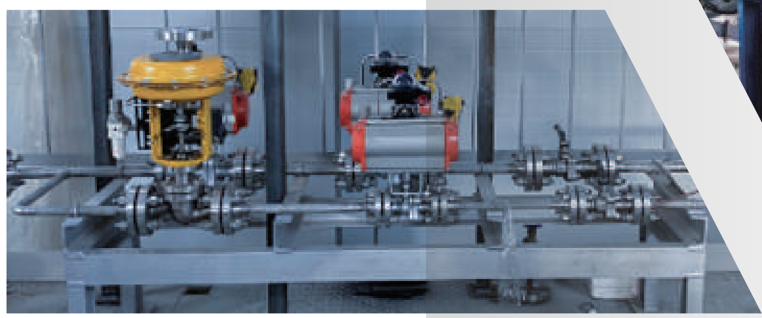






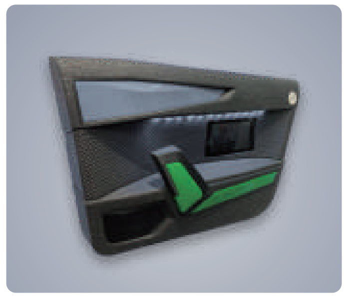





Application of EPP Product

Technical Molded Parts

EPP is indispensable in several industries such as in car manufacturing. Thanks to their outstanding energy-absorbing properties, EPP parts improve passive safety and provide better protection for vehicle occupants. Accordingly, they are used to make fenders, headrests, and other impact absorbers. EPP can absorb even more energy when used in combination with metal.

EPP Electronic Packaging Products

General packaging and
anti-static packaging of electronic goods.



EPP HVAC & Thermal Insulating

The thermal properties of EPP make it perfect for the heating, ventilation, air-conditioning and refrigeration (HVAC-R) industry.



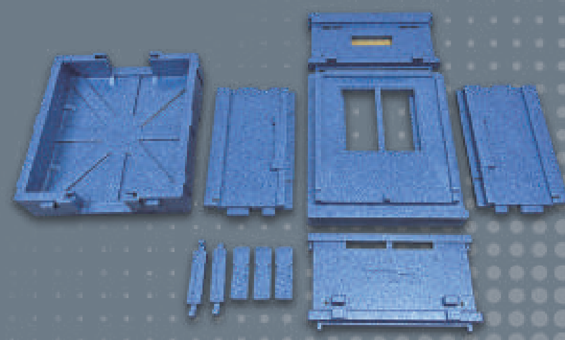

EPP Beehive

EPP hives, which have been widely spread recently, solve the problems of the existing hives and ensure a comfortable life for bees, especially in extreme cold and humid weather. Because of the easier maintenance and the higher harvest of honey over 30%, beekeepers came to actively use EPP hives.

- 30% increase in harvest
- Excellent insulation
- Moisture resistance
- Ultra lightweight
- 100% recycle







EPP PRODUCT

EPP Furniture, Bean Bag Filler

EPP materials are environmentally friendly and 100% recyclable. The EPP furniture is easy to move and assemble. More EPP furniture will be developed in the future. Kids furnitures made out of EPP are light-weighted and safe for the children to handle. EPP is strong enough to be used as a chair, a bed, and a mattress, to name a few. It is easy to have various colors.

EPP Home Applications

EPP products are used in many home applications such as baby hip seat, ironing boards, bathroom mats, cushion mats, children's toilet seats, flowerpots, stationery desk mats, wine cooler, etc.

EPP Health and Sports

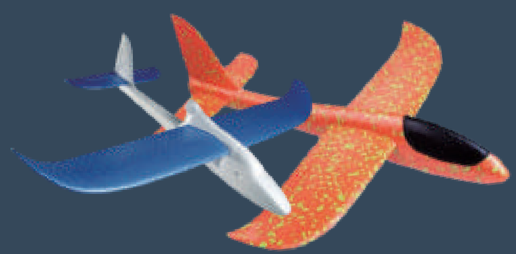
EPP has been used to make a variety of health and sport products: climbing, skiing, horseback riding, skateboarding, surfing, baseball and cycling helmets, ski boot insoles, body boards, swimming floats, body protection, shin pads, bicycle rims, athletic yoga rolls, etc.

EPP Hot, Cold & Fresh Food Box

EPP BOX is a revolutionary new high density EPP series of containers in which hot or cold items can be transported with an average temperature loss of less than 1°C plus or minus per hour within a temperature range of -40°C to +120°C.

EPP Leisure and Activities

Numerous model airplanes, artificial turf and playing pieces have been made out of EPP because of the safety, lightweight, and excellent mechanical properties.



EPP Buoys

EPP is the most suitable material for buoys because it doesn't contain heavy metals which are harmful to the marine life. Also, EPP buoys are durable, so their cracking (and thereby marine pollution) will be minimized.