

FRONTIER, INC.

Updated: Dec. 27, 2022

Originator: R&D Center

2-Stage Type Biaxial Stretch Blow Molding Machine Line-up

Describes 8 series which are sold frequently in recent years.

Contents	FRB1	FFB	FB	FR	FX	FGB	FYB	FMB
Beverage	✓	✓	✓	✓	✓	✓		
Dairy beverages	✓	✓	✓	✓	✓			
General foods	✓	✓	✓	✓	✓			
Seasonings, oils	✓	✓	✓	✓	✓	✓		
Cosmetics	✓	✓			✓		✓	✓
Pharmaceuticals	✓	✓	✓	✓	✓		✓	✓
Daily goods	✓	✓					✓	✓
Industrial supplies		✓				✓		✓

Container Type	FRB1	FFB	FB	FR	FX	FGB	FYB	FMB
3 liters or less	✓	✓	✓	✓	✓		✓	✓
4 to 9 liters				✓		✓		
10 liters or more				✓		✓		
Container with handle	✓	✓	✓		✓			
High Heat-resistant container					✓			
Heat resistance container	✓	✓		✓	✓			
Wide mouth container							✓	

2-Stage Type Biaxial Stretch Blow Molding Machine Line-up

FFB



4th generation general-purpose linear model

FB



High performance 5th generation linear model

FR



Japan made Rotary model

FX



Scalar robot adopted multi-functional model

FGB

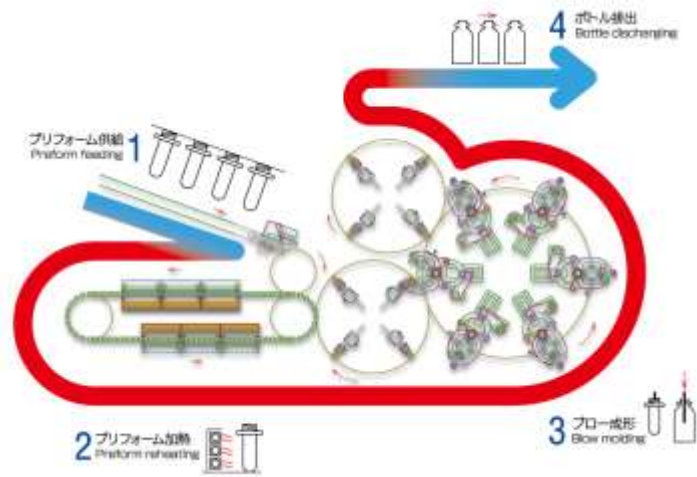


Dedicated large container

FYB



Thick-walled bottle and Cosmetic containers



Toward an Easy-to-Use Blowing Machine

Since developing our blow molding machine, we have been focusing on clean operation of pneumatic and electric drives. In recent years, we have standardized energy-saving heater, blow-air recycle, and other environmentally friendly systems.

Our line-up and technical capabilities, which are rich in variations, will meet your demand.

Stable high-quality and High-cycle molding

Our machinery uses a 2-stage process and adapt the most suitable 2-axis blow molding method for PET resin and other resin. Preform and Bottles are molded separately, so it is easy to adjust each to the optimum conditions. This is a molding method that can realize stable quality and high-speed production.



Comprehensive stretch blow molding engineering

Efforts
Development
of new products

Initiatives
Improvement
of existing products

Initiatives
Harnessing
of new technology

- Fabrication of 3D modeling
- Weight reduction
- Molding efficiency
- Prototype test
- CO2 reduction technology
- Blowing of new materials
- Sample bottle for line-test
- Prototype with alternative materials
- To develop new technology

Towards blowing machines that can respond to your request!

If you have any problems, please feel free to contact us!

Molding test results

Formability... ◎: Mass production record/●: Prototype test experience, good blow performance/▲: Prototype test experience, no mass production

Abbreviated name	Fomal name	Purpose	Feature	Formability	Transparency	Heat resistance	Chemical resistance	Gas Barrier property	Impact resistance
PET	Polyethylene terephthalate	Beverages, foodstuffs, cosmetics and industrial parts	Ideal for 2 axis stretch blow molding	◎	○	△	○	○	○
rPET	Recycled PET resin	Beverages, foodstuffs, cosmetics	Repeated use of PET	◎	○	△	○	○	○
Bio PET	Bio PET resin	Beverages, foodstuffs, cosmetics	Attention is focused on reducing oil consumption	◎	○	△	○	○	○
PET-G	Polyester with Glycol Additive resin	Cosmetics	Improved version of PET	◎	○	○	○	○	○
PEN	PolyethylenN naphthalate	Cosmetics, industrial parts, pressure-resistant containers	PET's top-ranked materials	◎	○	○	○	○	○
PEF	Polyethylene flanoate	Beverages	Bio 100%	◎	△	△	△	○	
PP	Polypropylene	Pharmaceuticals, foodstuffs, cosmetics, stationery goods	Crystalline general purpose resin, floats in water	◎	△	○	○	△	○
HDPE	High density polyethylene	Detergents, toiletries, medical supplies, tablets	High chemical resistance	◎	△	○	○	△	○
LDPE	Low density polyethylene	Pharmaceuticals	Softer than HDPE	●	△	△	○	△	○
BioPE	Bio polyethylene	Tablets, powders	Raw material is sugar cane	◎	△	○	○	△	○
Tritan	Copolyester	Beverages, baby bottles	Washable with dishwasher	◎	○	○	○	○	○
ECOZEN	Bio-copolyester	Beverages, cosmetics	Bisphenol-A free	◎	○	○	○	○	○
COP	Cyclic Olefin Polymer	Pharmaceuticals	Developed as a glass substitute	◎	○	○	○	△	○
COC	Cyclic Olefin Copolymer	Pharmaceuticals	Used in optical products and precision lenses	●	○	○	○	△	△
PA	Polyamide Nylon	Cosmetics	High toughness and excellent wear resistance characteristics	◎	△	○	○	△	○
PC	Polycarbonate	Gallon container	Excellent impact resistance	◎	○	○	△	△	○
TPX	Polymethylpentene	Heat-resistant container	High transparency, high heat resistance	●	○	○	○	×	×
TPU	Thermoplastic Polyurethanes		Intermediate hardness between rubber and plastic	●	△	△	○	△	○
PHBH	Biodegradable polymer		Ocean biodegradable	▲	△	×	×	×	×
Mapka	Plastic + Paper powder		Can be disposed of as paper	●	×	○	×	×	○
PLA	Polylactic acid		Bio-resin	●	○	×			×
PLA+CMF	Polylactic acid + Cellulose microfiber		Expected to strengthen PLA	●	×	△	×	×	△
HEMIX	Hemicellulose-derived bio resin		Up-cycle resin	●	×	○	×	×	△
ALTESTER	Polyester	Beverages, cosmetics and pharmaceuticals	Tg is 30° C higher than PET	●	○	△			
LCP	Liquid crystal polymer		Rigid rod-like structure	▲	△	○	○	○	△
Grilamid	Highly functional polyamide		Light and shock resistant	●	○	△	○	△	○
Cellbrane	Cellulose acetate		Non-edible plant-based resin	●	△				
Heimilan	Ionomer	Vacuum pack	Elongate well when heat is applied	●	○	△	△	△	○
ASA	Acrylonitrile, styrene, and acrylic rubber		Better weather resistance than ASB	●	△	△	△	△	○
HIPS	High-impact polystyrene	Lactic Acid Bacteria, Milk Drinks	Impact-resistant UP with GPPS + rubber	●	△	△			○
PMMA	Poly(methyl methacrylate)		Transparency over glass	●	○	△	△	△	○
U-Polymer	Polyarylate		High transparency	●	○	○	△	△	○

Power consumption of our latest machine

Electricity Consumption of FR Series

Electricity consumption per gram: **0.1~0.2W/g**

Full renewal of the heating zone

- Improvement of wavelength
- Air temperature control optimization
- High-efficiency heater box



Results

- 40% reduction in preform heating time.
- Power consumption reduced by 30% compared to our previous models.

Innovations in preform heating technology and higher efficiency of the equipment have led to a significant reduction in power consumption.

Power reduction measures

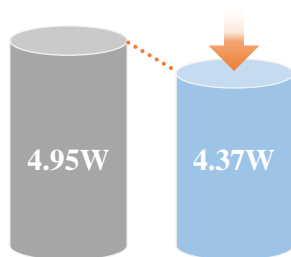
Preform
4g weight
reduction



Due to reduced
product weight

-12%

Energy saving!



Conventional
PF

Weight
reduction PF

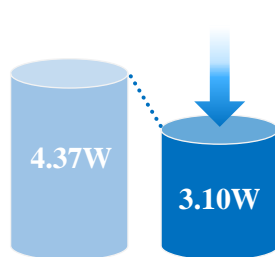
Latest
model



Comparison with
our previous
models

-29%

Energy saving!



Previous
model

Latest
model

Lightweight preforms + latest model
Energy-saving efficiency

Power consumption **-37%**

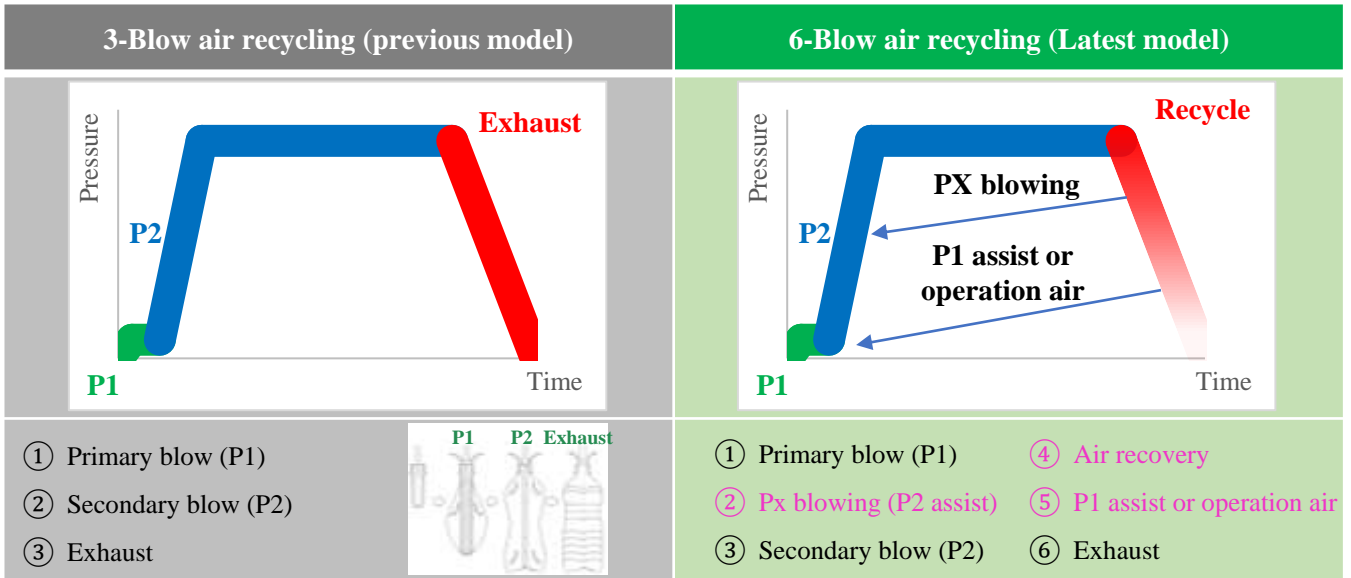
Annual CO² savings **-41ton**

Back data
8,424BPH, 22 hours/day, 22 days/month and 12 months of operation
Production volume... 48,926K bottles,
Differences in power consumed per bottle... 1.85W
To reduce 90,513 KW of power consumed annually
CO₂ emission factor Chubu Electric Power 0.462kg-CO₂/kWh

Previous model: BIO-F4LIII, 4Cav, 3,780BPH, Net-power consumption 18.7kW
Latest models: FR-6M, 6Cav, 8,424BPH, Net-power consumption 26.1kW

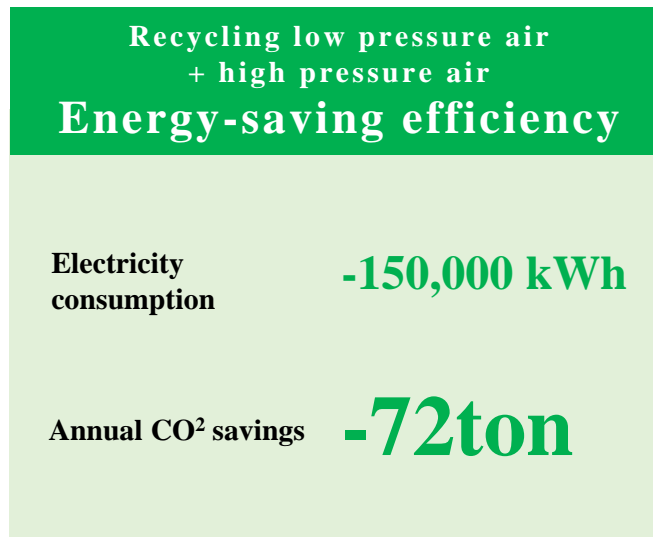
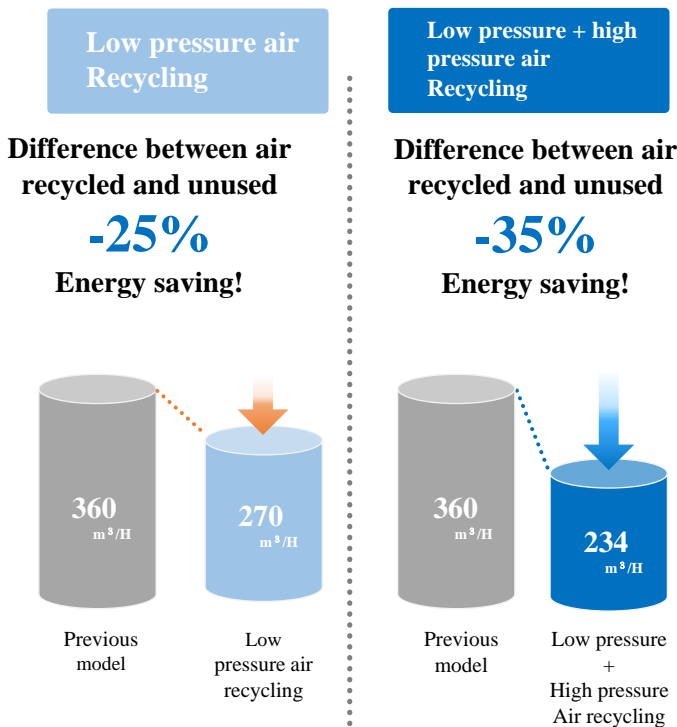
※ The above power consumption does not include the power consumption of auxiliary equipment.

Reduced power consumption through improved air recycling rates



Air consumption is reduced by 35% by reusing of exhaust air!
Energy-saving synergistic effect by reducing compressor operating time !

Power reduction measures



Back data
500ml 9,000BPH bottle-only power consumption.
Annual production hours: 258 days × 24H = 6,192H/year
Compressor Power Consumption Operating Rate 90%: 0.2kwh/m³
CO₂ emission factor Chubu Electric Power 0.462kg-CO₂/kWh

※ Figures are relative to those of us. Recycling efficiency varies with bottle volume and production number.

RFID tag insert bottle

Radio Frequency Identification

Next-generation technology PAT.

Partner company SATO Holdings Corporation

- Neck piece... 3g
- Preform...16g



Patent No. 7182233



Patent No. 6857375



Introductory videos are from above.

- An RFID tag was inserted into the neck of the bottle

Stack preform method	Neck piece insert method
Blow with an overlay of preforms for the inner and outer layers.	This is a structure in which the neck and body are divided. Molding properties are not different from those of single-layer preforms.

- RFID has reduced readability in the vicinity of liquid and or metals.
⇒ Solved by putting RFID tag in to the necks section!
- Appeal to brand protection, realization of unmanned cash registers, and inventory management.
- Bottles whose traceability has been established during chemical management and/or export to overseas.
- Facilities for producing RFID insert bottles are under intensive consideration.
 1. RFID tag applicator
 2. Neck piece assembler
 3. Neck separation method

NFC tag insert container

Near field communication

Next-generation technology PAT.



Patent No. 7082841

- Two-layer structure bottle technology
 - Inner layer by Stretch blow molding method
 - Outer layer by Cast molding method
- Plant-derived thermosetting resin is used as an outer layer material.
- Excellent heat resistance, designability and chemical resistance.
- Soft touch and non-slip container.
- Built-in NFC tag at bottom of container.
 - Prevents damaging and forgery of NFC tag
- NFC can be read and written by smartphones. Therefore, it is possible to appeal the needs of additional purchases and regular purchases on the EC site.

Paper Sleeve Bottle

Reduction of resin usage and thin-wall bottle reinforcement technology

Partner company Oji Holdings Corporation

- PET...16g
- Paper-sleeve...10g



- There is a limit to the weight reduction of bottles in terms of strength. Therefore, we worked to develop technology to reinforce the bottles with paper sleeves to further reduce their weight.
- In-mold molding method is adopted, and the paper sleeves and bottles are bonded together by heat during blow molding.
- The material of paper sleeves pulp recycled from used paper such as newspapers and magazines. In addition, in consideration of paper recycling after use, it is printed with ink that does not affect recycling.
- Paper and PET can be separated and recyclable after use.

Thin-walled flat bottle

Proposal of waste plastics reduce and recycling-oriented utilization methods

Partner company Japan polyethylene Corporation and Oji Holdings Corporation

- LDPE...8g
- Paper outer case...12g



- Successful equalization of Thin-walled flat bottle wall thickness by adopting double blow molding method. The wall thickness of LDPE container is 0.2mm on the long side and 0.1mm on the short side.
- This is a molding technology that enables thin-walled flat containers for PET,HDPE,PP and TPX plastics.
- This is a technology to appeal to the demand for sale using refill containers.
- Thin containers are available for mailing, so we will seek to reduce distribution costs.

Bottle-to-Bottle proposal

Recycled PET below IV0.6 is reused as bottles.



- Bottled textile-and sheet-grade rPET
- Developed a technology for recycling into bottles by adding a modifier to recycled material that has not been Solid-State Polymerized.
- Reduced energy and equipment costs if reusable without solid-State Polymerization.
- Repeated regeneration of PET decreases the physical properties. Therefore, we aim to obtain a recycled material suitable for blow molding by mixing modifiers and restoring IV and physical properties.

Utilization of overseas recycled PET bottle



- Since domestic r-PET in Japan has exceeded demand for supplies and is rising in prices, the effective use of low IV recycled PET materials made from overseas was investigated.
- Implemented prototype blending with virgin PET and modifying agents.

Barrier bottle

Proposal for Outer Layer Coated Bottle



- Proposed high value-added container by alternative technique of Diamond-Like Carbon coating.
- Two-layer coating was applied to the outer layer surface of PET bottles. Barrier performance tests confirmed the effectiveness.

Primary layer	Secondary layer
Barrier	Protection

Flow chart of PET recycle

Common

- 1 Collection 
- 2 Sorting 
- 3 Grinding 
- 4 Cleaning 
- 5 Flaking 

Chemical

- 6 Depolymerization 
- 7 Decolorization Refining 
- 8 Melt polymerization 
- 9 Solid-State Polymerization 
- 10 PET resin 

Mechanical

- 6 Pelletizing 
- 7 Crystallization 
- 8 Solid-State Polymerization 
- 9 PET resin 

New B-to-B

- 6 Pelletizing 
- 7 PET resin 
- 8 Add modifier mixing virgin resin 

What is Solid-State Polymerization?

- The solid-state polymerization is a step of performing heating and stirring while charging nitrogen in a vacuum environment. It consists of five steps: crystallization, drying, heating (secondary crystallization), polymerization, and cooling.
- By carrying out the solid-state polymerization, molecules are polymerized with each other, and the strength (IV) of the resin is increased. Further, the solid-state polymerization has an effect of reducing impurities contained in the raw material resin.

What is IV

- That is Intrinsic viscosity.
- IV value are reduced by heat.
- Suitable IV for 2 axis stretch blow molding is 0.80
- Suitable IV for sheet-forming is 0.72
- Suitable IV for Film-processing is 0.65
- Suitable IV for textile is 0.58

IV	Typical applications
0.80	Bottle
0.72	Sheet (egg pack, etc.)
0.65	Film
0.58	Long and short fibers
0.52	Short fiber

CIF value for PET resin

- Prices for imported CIF of virgin PET
- Source: Trade Statistics, Ministry of Finance
- CIF:Cost Insurance and Freight, including freight charges (in JPY/Kg)

Year/month	CIF value
2021/01	86
2021/02	91
2021/03	97
2021/04	111
2021/05	120
2021/06	122
2021/07	122
2021/08	120
2021/09	124
2021/10	126
2021/11	131
2021/12	138
2022/01	143
2022/02	140
2022/03	145
2022/04	160
2022/05	174
2022/06	177
2022/07	188
2022/08	188
2022/09	188
2022/10	188

Hemicellulose Biomass PET



Transparent bottles From Beer residues

- We learned that hemicellulose is abundantly contained in plant residues, which are discharged during the processing of foodstuffs made from barley (Beer etc.) and soybeans (Tofu etc.), but most of them are disposed of. We thought that this hemicellulose could not be effectively used, and we have developed a biomass-based PET resin by own formulation.
- Cellulosic resins are generally opaque, but this material provides a highly transparent bottles. Also, blow-moldability does not differ from common biomass-based PET.

Polylactic acid + Cellulose compound



- This bottle is made from cellulosic material extracted from old cotton clothing, and is made from a compound of PLA.
- Initiatives to reclaim plants that should be disposed of with new value.
- The falling impact performance is improved by compounding cellulose into PLA.

PET + TPX blending

Partner company Mitsui Chemicals, Inc.



- The white masterbatch is generally blended with titanium oxide.
- Study TPX blending as a substitute for titanium-oxide. When PET and TPX are blended, they become cloudy with light refraction and irregular reflection. This bottle is light-resistant by taking advantage of this property.
- TPX is an organic substance, so it is easy to chemically PET recycle.

PET+TPX blending

Results of light shielding test

Partner company Mitsui Chemicals Inc,



Test purpose

- The exposure of milk, beer and wine to sunlight and illumination produces an off-flavor called sun odor.
- Shading property is required as a measure against sun odor. As measures in plastic bottles, white masterbatch (MB) blending is mentioned.
- However, the titania contained in the white MB was suspected to be brittle, we were looking for a substitute for the white MB.
- We discovered that blending TPX into PET makes it pearl-tone white. It became a substitute for white MB or measured the shading performance of TPX blended products.

In-house measurement data

Test method

- Cut out the test piece from the bottle, and measure the transmittance.
- Conducted at Nagano Prefectural Industrial Technology Center.

Measuring instrument Ultraviolet-visible near-infrared spectrophotometer

Manufacturer Japan Spectroscopy Co., Ltd.

Model V-670



Measurement results

- Transmittance at 400nm wave length is compared.

Please contact us for details

- Though the light shielding property in the ultraviolet wavelength region is inferior to the white MB, it is excellent in the other wavelength region.

Please contact us for details

HDPE

HDPE bottles without pinch-off

Partner company Japan polyethylene Corporation.



- Made by 2 axis stretch single blow system
- Compared to direct blow, the dimensional accuracy of the threaded portion is high and trimming is not required.
- Improved falling impact performance due to no pinch-off process in the stretch blow bottle.
- Mold flush less.
- Loss can be reduced at the start of mass production.
- Bottle weight loss is possible compare with direct blow method.

PET containers compatible with hypochlorite

Partner company Mitsubishi Gas Chemical Company, Inc.



Mitsubishi Gas Chemical HP
News release

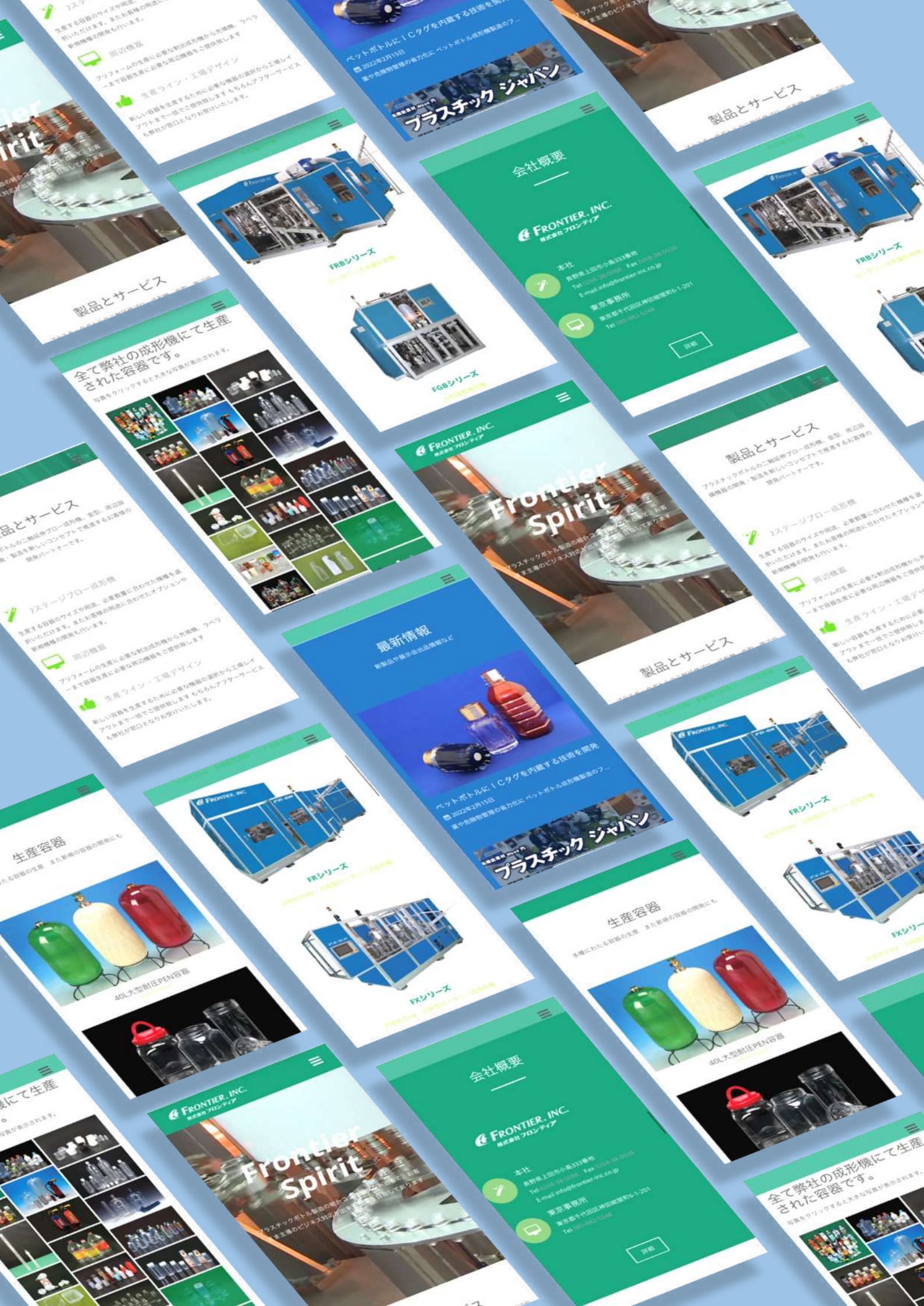
- From the viewpoint of environmental friendliness, the movement to switch the bleach bottles from HDPE to PET exists in the global market.
- MX nylon with excellent gas barrier and chemical resistance → **Compatible with hypochlorite as well**
- Mitsubishi Gas Chemical evaluated and verified the contents and cracking resistance.
- Be mass-produced overseas.

51% paper content bottle

Partner company Mitsubishi Gas Chemical Company, Inc.



- This container can reduce calories at incineration compared to a 100% resin container
- By adopting PP as a binder, it is excellent in heat resistance performance. The container was filled with 98°C liquid and allowed to cool naturally. The deformation rate was 0.85%.
- Clear 10 drop tests from the height of 1.2m.



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生産容器



40L大型射圧PEN容器

成形機にて生産



FRONTIER, INC.
株式会社 フロンティア



会社概要

FRONTIER, INC.
株式会社 フロンティア

本社
長野県上田市内小島333番地
Tel: 026-254-2111 Fax: 026-254-2121
E-mail: info@frontier-inc.co.jp

東京事務所
東京都千代田区神田錦町6-1-201
Tel: 03-5561-3248

詳細

最新情報

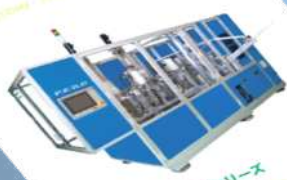
新製品や展示会出展情報など



ベストボトルにICタグを内蔵する技術を開発
2022年2月15日
高次元物流管理の普及化に、ベストボトル成形機製造のフー



プラスチック ジャパン

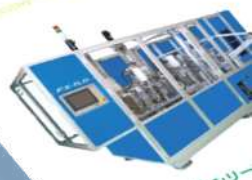


FRシリーズ

高次元物流管理の普及化に、ベストボトル成形機製造のフー



40L大型射圧PEN容器



FRシリーズ

高次元物流管理の普及化に、ベストボトル成形機製造のフー

会社概要

FRONTIER, INC.
株式会社 フロンティア

本社
長野県上田市内小島333番地
Tel: 026-254-2111 Fax: 026-254-2121
E-mail: info@frontier-inc.co.jp

東京事務所
東京都千代田区神田錦町6-1-201
Tel: 03-5561-3248

詳細

生産容器

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40L大型射圧PEN容器



FRシリーズ

高次元物流管理の普及化に、ベストボトル成形機製造のフー

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