ASB
Form Your Vision

NISSEI ASB MACHINE CO., LTD.

INTERNATIONAL PLASTIC
PACKAGING TECHNOLOGIES CONGRESS
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PET Containers for Hot Filled Food Products : No Preservatives!

Paul Atkin - Nissei ASB Machine Co., Ltd. - Japan

Topics

1. Introduction to ASB
2. About Hot Fill & Pasteurization
3. Container Filling Process
4. Advantages of Double Blow
5. Container Molding Process
6. Nissei ASB's HSB Series Line-up

Nissei ASB - Introduction

- Founded in 1978 in Nagano, Japan
- Factories in 2 countries, 19 subsidiaries, machine sales in over 129 countries
- Nissei ASB continues as a world leader in Injection Stretch Blow Molding specializing in the single stage process for molding high value custom molded products.

Presence In Turkey

- Nissei ASB has been present in Turkey for over 30 years
- Over 280 machines and 350 mold sets already supplied into the Turkish market
- Local sales and technical service & support;
  - Erensoy Ltd., based in Istanbul
  - Nissei ASB GmbH, Dusseldorf, Germany.

Why do some products require hot filling?

HOT FILLING – WHAT IS IT FOR?

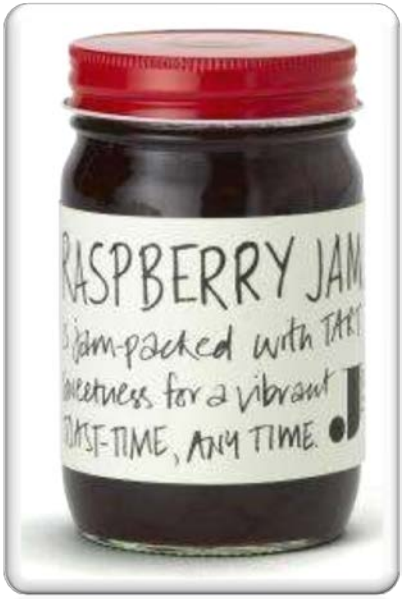
Hot Fill – What & Why?

- Pasteurization may be used just prior to filling to kill bacteria in sensitive foods and beverages
- Decontamination can be enhanced by further pasteurization of the product after filling
- Ensures containers and caps are bacteria free, no additional sterilization process is required
- Hot filling can aid the filling of high viscosity products
- Hot fill PET bottles have existed a long time, but hot fillable jars were only recently launched by ASB.

Products – Juices, Tea, Ketchup

Products - Pickles

Products – Jam / Marmalade



Products – Pasta Sauces / Condiments

Products – Purees / Curry Sauces

Products – Turkish Specialities

Hot Fill PET Jars Already In The Global Market

Hot Fill Sauces In The Turkish Market

Heat Resistant PET Bottles

- Hot fill PET bottles have existed for many years
- Traditionally known to be heavier with less design options
- Now, lighter weights and greater diversity of design are possible
- Necks may be amorphous or crystallized depending on container specification.

What's Special About Hot Fill PET Jars?

- As neck sizes increase, the difficulty of forming a reliable heat resistant neck increases exponentially
- Industry standard metal cap designs place additional burdens to preventing neck deformation and leakage
- Continued improvements in process optimization now make hot fillable PET jars a viable packaging solution.
- Global sales opportunities are enormous - in western Europe alone, in excess of 5 billion jars are hot filled per year.

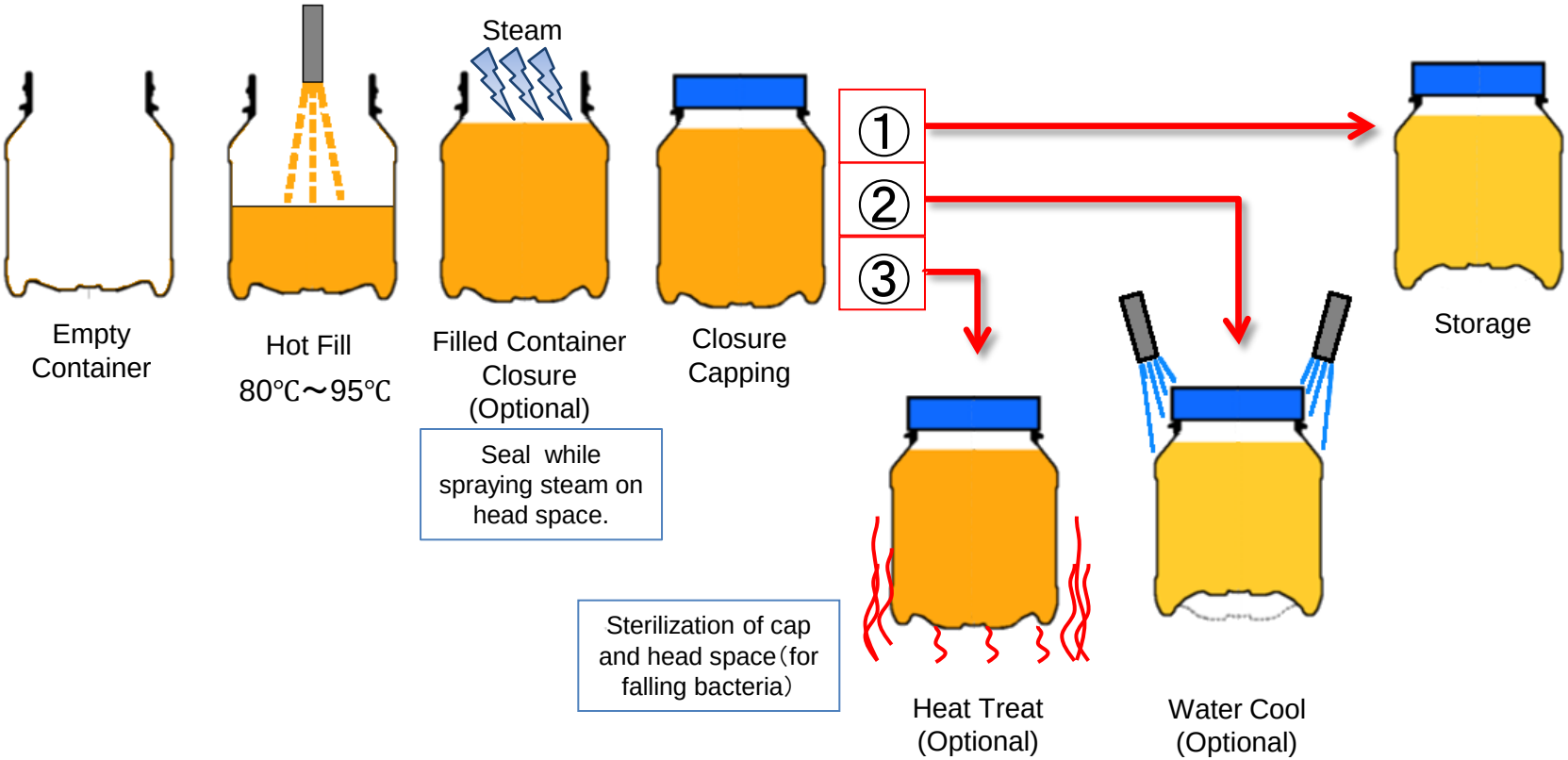
Hot filling technique varies depending on the product

CONTAINER FILLING PROCESS

Common Categories of Hot Filling & Pasteurization Methods

1. Hot fill + forced or natural cooling
2. Hot fill + pasteurization + cooling
3. Cool / Warm fill + pasteurization + cooling
4. Pressure balanced autoclave + cooling

Typical Hot Fill Methods



Apple Sauce Example

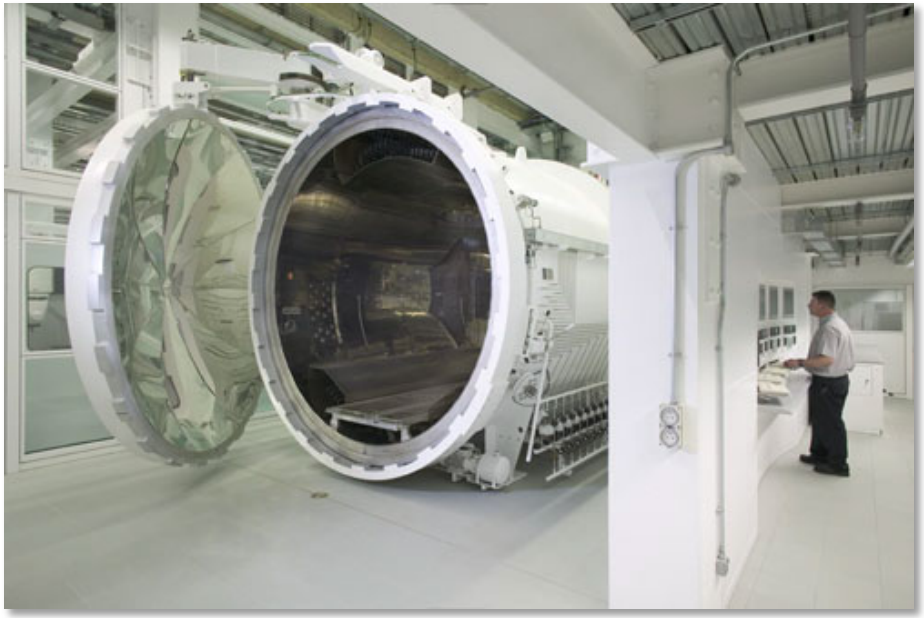
- Example 1
  - Fill at 85-90°C
  - Steam flash and cap
  - Pasteurization at 92°C for 5 min
  - Cooling for 20 min until 40°C

- Example 2
  - Vacuum fill at 85-90°C
  - Steam flash and cap
  - Pasteurization at 95 °C for 3 min, 90 °C for 23 min
  - Cooling for 20 min.

European Pickled Vegetable Example

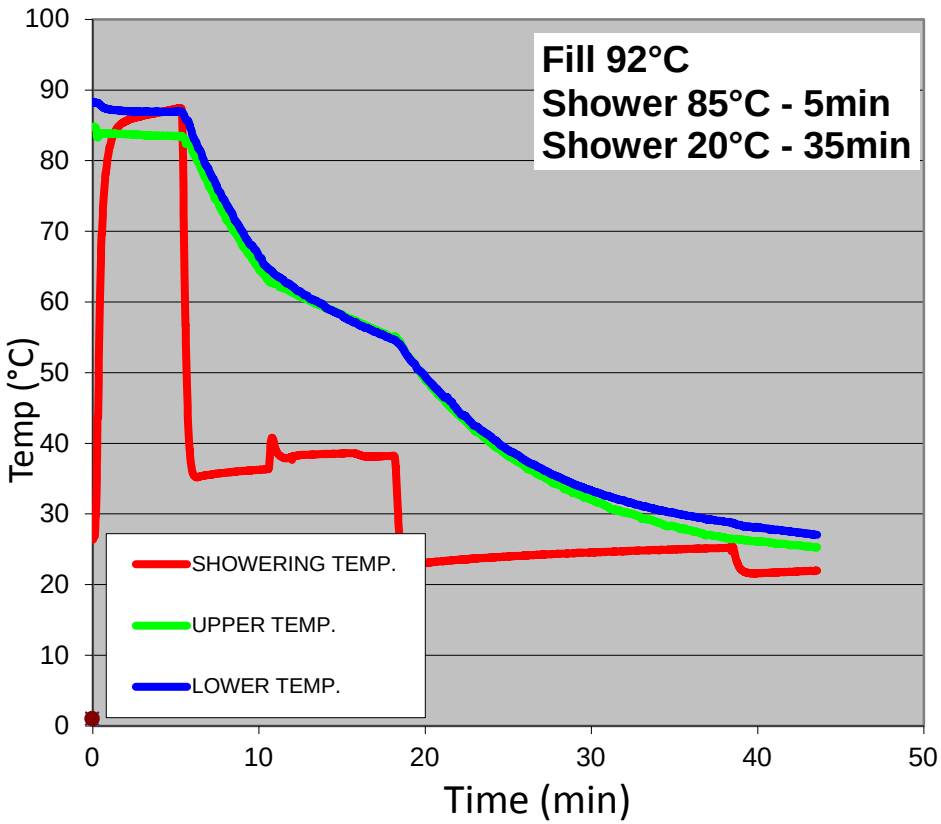
- Filling temperature: approx. 40°C
- Fill height: just below the support ring
- Vacuum capping: 150-200 mbar
- Autoclaving: core temperature is 83°C for 9 minutes
- Full autoclave process

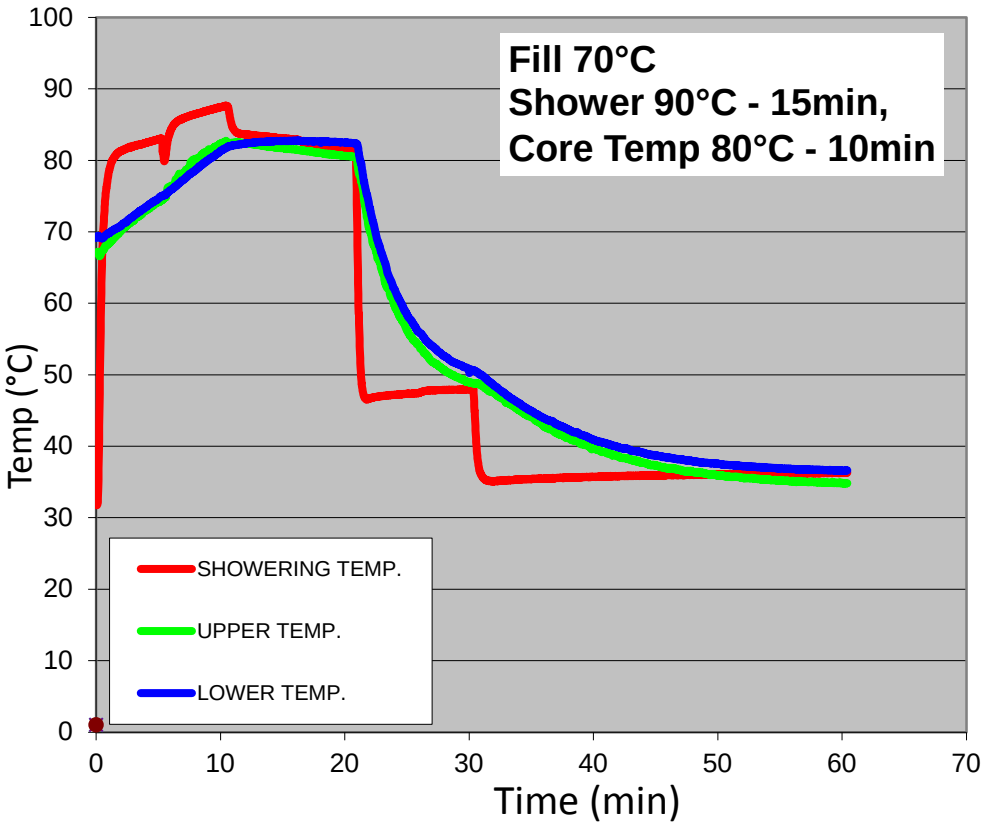
Time	Temp	Overpressure
5’	70°C	0 bar
5’	85°C	1 bar
35’	85°C	1 bar
5’	75°C	0.9 bar
5’	65°C	0.8 bar
5’	50°C	0.5 bar
15’	30°C	0 bar



Example of industrial autoclave

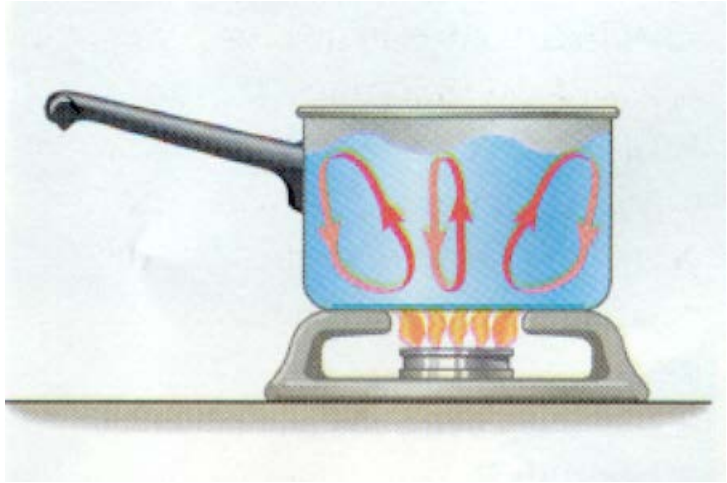
Example Fill, Pasteurize & Cool Profiles

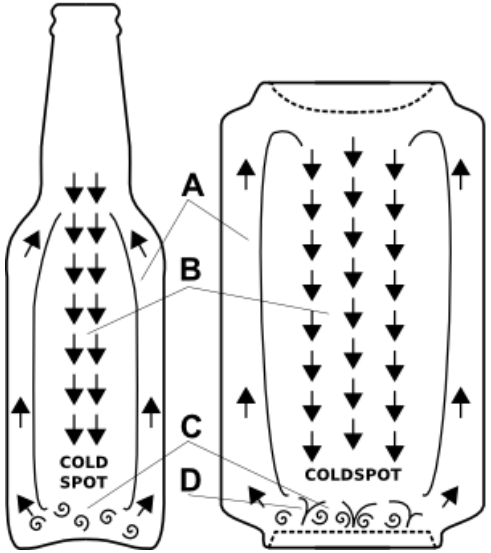




High Viscosity Filling Considerations

- Increased temperature provides drop in viscosity for better and faster filling
- High viscosity reduces convection currents inside the container – pasteurization and cooling takes longer time.





Heat Resistance & Design

Overall hot fill specification of a container is a result of;

- Container
  - Shape (brand image)
  - Panel design
  - Weight
  - Molding conditions
- Food Product
  - Filling temperature
  - pH value
  - Viscosity
  - Headspace
  - Post fill cooling, etc.

Design Optimization

- ASB's double blow heat set process can cater to most hot fill / pasteurization requirements
- After analyzing the required filling / pasteurization parameters, container specification can be customized as required.

ASB's double blow heat setting provides unique advantages

ADVANTAGES OF DOUBLE BLOW

Why Use ASB's Double Blow Heat Setting Process

- Higher molding temperature used in double blow allows;
  - High crystallinity density / high clarity
  - 90-95°C hot fill using standard PET resins
  - Greater diversity of container designs
  - Bottles and wide mouthed jars
  - Greater gas barrier
  - Longer storage life of empty containers.

Enhancing Gas Barrier in Hot Fill Containers

1. Double blow technique increases gas barrier by about 1.3 times over conventional molding
2. “Standard” barrier enhancers can also be used;
   - A range of additives such as oxygen scavengers, barrier materials can be blended
   - Post molding barrier can be added via a variety of coating methods including internal plasma coating.

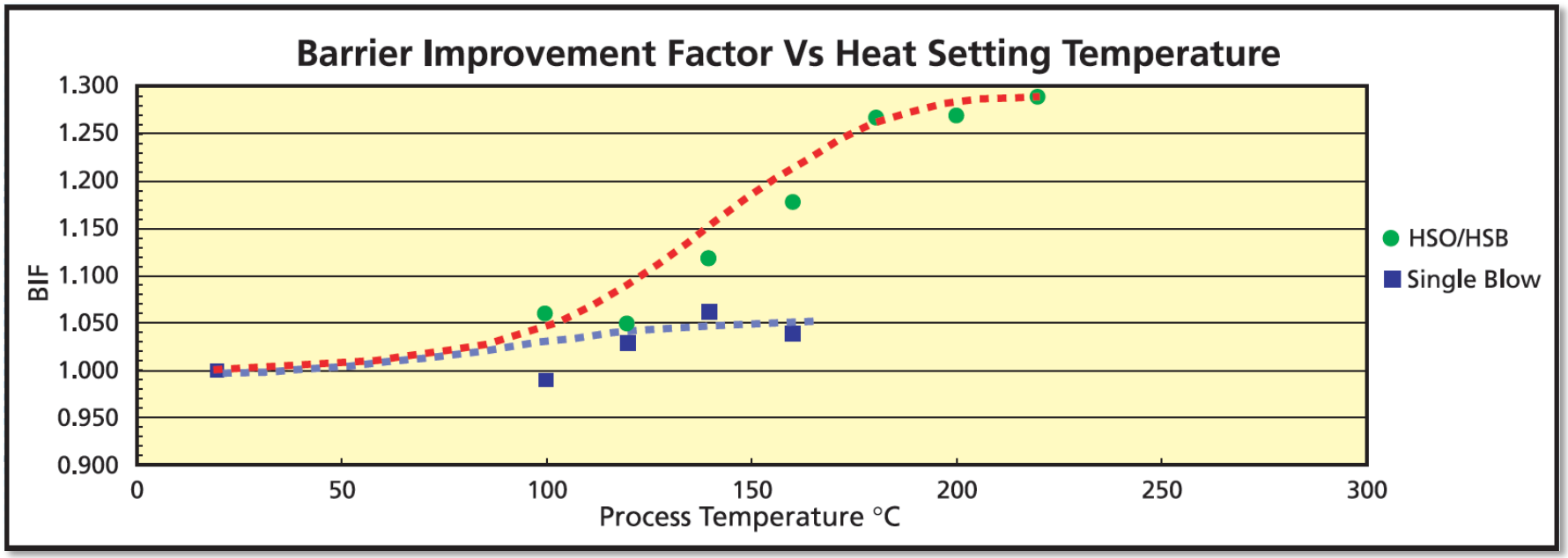
PET Crystallization Rate

Molding Method	Heat Set Temp.	Crystallization Density	Crystallization Density (%)
Standard Blow	—	< 1.36	—
Heat Set Single Blow	140°C	1.370 ～1.375	32 ~ 35
HSB Double Blow	180°C	**1.380～1.390**	**40 ~ 41**

Gas Barrier & Container Storage life

Molding Method	O_2 Barrier	CO_2 Barrier	Storage Life Improvement (per 6 months)
Standard Blow	1	1	—
Heat Set Single Blow	1.05	1.05	1 week
HSB Double Blow	**1.3**	**1.3**	**2 months**

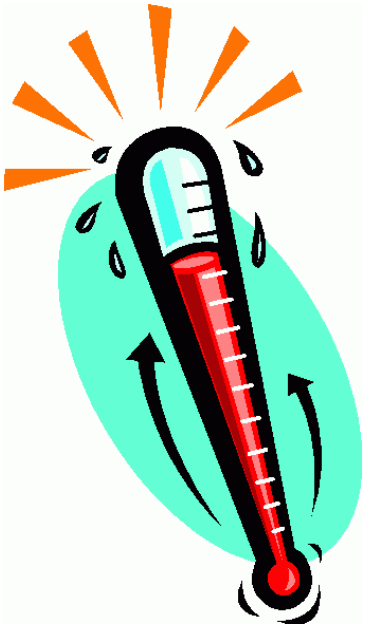
Barrier Improvement Factor



Higher process temperature used in double blow results in improved gas barrier.

Advantages of Double Blow Hot Fill Over Alternatives

- Higher temperature resistance from standard molding materials, up to 95°C
- Provides simple monitoring of the filling process
- Compared to aseptic filling, much lower costs for investment, staff training and maintenance of sterile production
- Vacuum seal at the cap created as a side effect provides easy checking and customer confidence



Advantages Over Glass

- Weight saving in material per container – raw material reduction and transport costs
  - 950ml glass jar – 375 grams
  - 950ml PET jar – 66 grams (17.6% of glass weight)
- Volume reduction in storage and transportation
- Breakages / contamination
- Recycling
- Carbon emissions in manufacturing and transport

Advantages Over EBM Polypropylene

- Image quality
- Neck finish quality
- Recyclable solution vs. multilayer

Step-by-step – how a hot fill PET container is made

CONTAINER MOLDING PROCESS

Neck & Body Challenges

- Heat softens the PET material
- Neck
  - Material deforms due to mechanical pressure from the cap
- Body
  - Oriented polymer chain molecules try to return to their pre-stretched condition
  - Vacuum inside the container allows external air pressure to collapse the body.

Basic Properties of PET

Oriented Amorphous	Property	Crystalline
Clear	Clarity	Opaque
Very Tough	Strength	Brittle
High	Stress	Low
~70°C	Softening Point	~250°C

- Hot filling requires
  - good clarity
  - high toughness
  - low stress
  - At least 80-95°C heat resistance.

The Solution

- During the molding process, the crystal structure of the raw material must be modified to provide the required properties;
  - Necks must be either;
    - Thicker (amorphous), or
    - Highly crystallized to resist capping forces, but must retain enough toughness to prevent cracking
  - Body must have adequate heat resistance against shrinkage and distortion but must also retain acceptable clarity.

Preform Molding

- Preforms are molded in one of ASB's PM Series vertical clamping injection machines providing highest quality
- In the case of crystallized necks, molded diameter must be larger than final target size.

Neck Crystallization

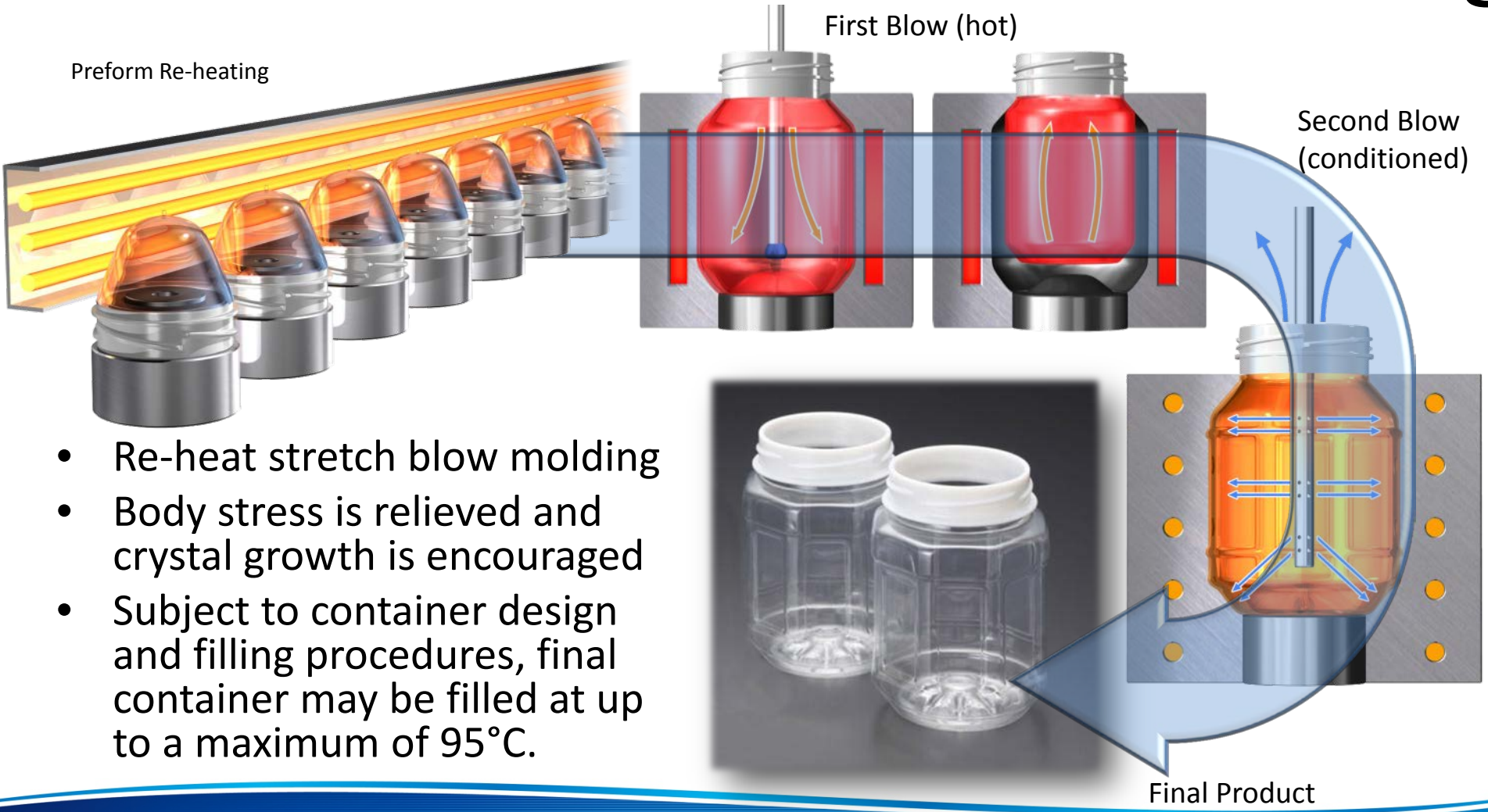
- Preform neck is processed in a CM Series machine to generate crystal growth
- Controlled heating of the neck part.

The Need For Neck Crystallization

Parameter \ Neck Size	28-38mm Bottle	Wide Mouth Jar
Filling Temp.	Yes / No	Yes
Pasteurization process	Yes / No	Yes
Laying over	Yes / No	Yes
Cooling method	Yes / No	Yes
Cap type / material	Yes / No	Yes

- In case of bottles, requirement for crystallization will depend on a combination of factors.
- For jars, all cases require crystallized necks.

Container Stretch Blow Molding



- Re-heat stretch blow molding
- Body stress is relieved and crystal growth is encouraged
- Subject to container design and filling procedures, final container may be filled at up to a maximum of 95°C.

Container Molding Steps

Injection Molded Preform	After Neck Crystallization	After First Blow Molding	After Final Blow Molding	Finished Container With Cap

Recommended PET Resin

- Far Eastern Textiles CB-651
  - ✓ Low IPA
  - ✓ Good crystal growth for high output
  - ✓ Good heat resistance
  - ✓ Competitively priced
  - ✓ Good availability.

Process Video CM-6000M + HSB6-M

ASB®
NISSEI ASB MACHINE CO., LTD.

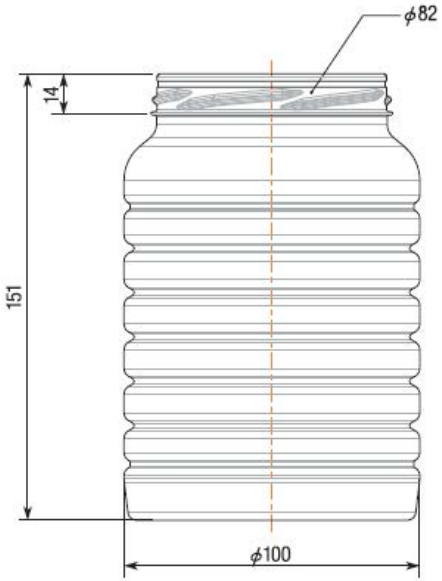
A range of machines for molding heat resistant PET containers

NISSEI ASB'S HOT FILL SOLUTIONS

Size-up – 63mm → 82mm → 110mm

- HSB-6M already in the market at 63mm
- HSB-2M already tested at 82mm
- 110mm advanced trials, close to market

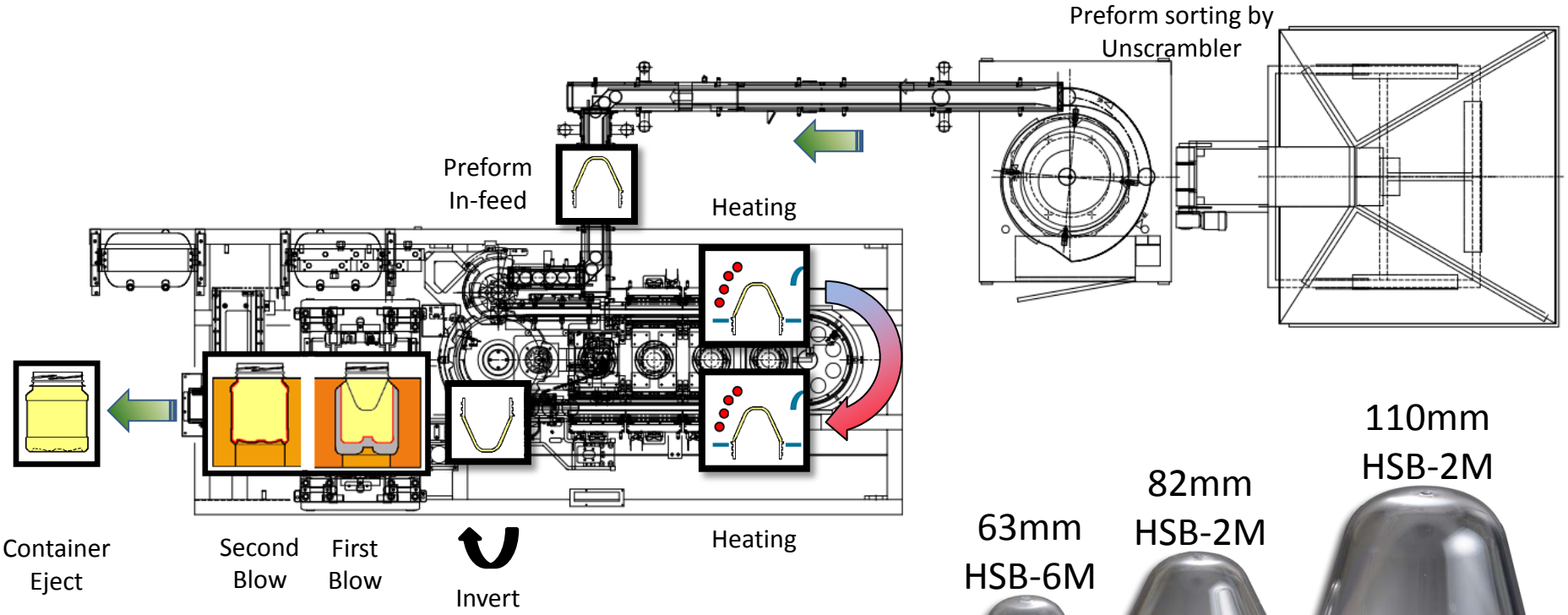
New for 2014



Machine	HSB-2M (2 cav)	HSB-2M (1 cav)
Neck diameter	82mm	110mm
Capacity	950ml	4L
Weight	66 gram	179 gram
Fill Temp.	Up to 95°C	
Applications	Pickles, sauces, fruit etc.	

- HSB-2M
- 82mm neck x 2 cavities (up to 1 liter)
- Up to 110mm neck in single cavity (up to 4 liters)
- CM-2000M for neck crystallizing

HSB-2M



PM Series – Vertical Injection Molding Machines for Bottle / Jar Preforms

- **PM-70/65NII**
  - 24 / 12 cavities
  - 28mm / 38mm neck
  - Max. weight: 32 gram / 64 gram

- **PM-70/111M**
  - 24 cavities
  - 63mm neck
  - Max. weight: 45 gram

- **PM-70/111M**
  - 12 cavities
  - 82mm neck
  - Max. weight: 66 gram

- **PM-170/111M**
  - 6 cavities
  - 110 mm neck
  - Max. weight: 145 gram

CM Series – Neck Crystallization

- **CM-6000N**
  - Up to 38mm neck preforms
  - Output: up to 6,000 pph
- **CM-6000M**
  - Up to 63mm neck preforms
  - Output: 6,000 pph
- **CM-12000M**
  - Up to 38mm neck preforms
  - Output: up to 12,000 pph
- **CM-2000M**
  - Up to 110mm neck preforms
  - Output: 2,000 pph

HSB Series – Double Blow Hot Fillable Container Molding Machines

- **HSB-4N (4 cavity)**
  - Bottles up to 2L, max. neck size: 38 mm
- **HSB-6N (6 cavity)**
  - Bottles up to 0.6L, max. neck size: 38 mm
- **HSB-2M (2 cavity)**
  - For jars up to 1L, max. neck size: 82 mm
- **HSB-2M (1 cavity)**
  - For jars up to 4L, max. neck size: 110 mm
- **HSB-6M (6 cavity)**
  - For jars up to 0.6L, max neck size: 63 mm

Typical Bottle Line Productivity

Process	28mm 500ml 26 gram	28mm 2000ml 55 gram
Preform	PM-70/65NII (24 cav)	PM-70/65NII (12 cav)
Output	6,000pph	2,400pph
Neck Crystallization*	CM-6000N	CM-6000N
Output	6,000pph	6,000pph
Blow Molding	HSB-6N	HSB-4N
Output	6,000bph	2,400bph

* Optional depending on container specification.

Typical Jar Line Productivity

Process	63mm 350ml 32 gram	63mm 500ml 39 gram	63mm 500ml 45 gram	82mm 950ml 66 gram
Preform	PM-170/111M (24 cav)	PM-170/111M (24 cav)	PM-170/111M (24 cav)	PM-170/111M (12 cav)
Output	5,400pph	5,000pph	4,800pph	2,038pph
Neck Crystallization	CM-6000M	CM-6000M	CM-6000M	CM-2000M
Output	6,000pph	6,000pph	6,000pph	2,000pph
Blow Molding	HSB-6M	HSB-6M	HSB-6M	HSB-2M
Output	5,400bph	5,100bph	4,800bph	1,440bph

Future machine development will depend on market demand for output and neck sizes

Thank You

Paul Atkin
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Japan
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