COMPLETE MILK BOTTLING LINE

ULTRA CLEAN VERSION

up to 28 800 bottles/h
SMF company offers a complete solution for dairies, supplying ULTRA CLEAN version of a bottling line for milk. The offer includes machinery and equipment such as:

1. **OPTIMA**
   - Fully electric PET blow moulding machine, output up to 28,800 BPH (bottle 1.0L)
   
   **Additional equipment:**
   - DUMPER DRH-500 – preform tilter automatic preforms loading system
   - Preform conveyor with preform orientation unit
   - Compressor station

2. **TRIBLOC**
   - RINSER – FILLER – CAPPER

3. **LABELLING MACHINE**

4. **PACKAGING MACHINE**
   - Bottles are grouped in batches, wrapped with shrinking foil creating a multi-pack.

5. **PALLETTIZER**

6. **CONVEYOR SYSTEM**
   - Air and plate conveyor system.
Milk plants process raw milk that they receive from farmers into marketable milk with a significantly extended shelf life. Each country has its own regulations for marketable milk production that have to be followed precisely. The quality of the processes and installations chosen will in turn affect the hygienic conditions and quality of final product. Each subsequent stage of milk production is performed carefully, hygiene and compliance are key factors which guarantee the quality of packed milk.

Below is a description of milk production and filling into PET bottles by use of modern technology ESL (Extended Shelf Life), which is the best way so far to extend the shelf life of milk distributed in a cold chain. Using this technology allows you to keep both the organoleptic properties of milk, the content of microelements, vitamins and flavor, which are slightly different from raw milk.

It is very important to provide the cold chain for keeping the quality of milk produced in the ESL technology. This can guarantee shelf life up to 21 days!

**ADVANTAGES OF PET BOTTLES**

- Significantly lower weight of the PET package than other materials such as glass or HDPE.
- Cost saving production of PET bottles up to 15g per bottle. Weight of 1L PET container is only 22,5g, while weight of 1L HDPE container is 38-40g.
- No material loss during production.
- Lower costs due to material saving and manufacturing technology (high efficiency, low power consumption, full automation of the process).
- PET offers better barrier against oxygen and better protection from odours than HDPE.
- Possibility of producing tailor-made bottles with original shapes, attractive and esthetic for customers – great marketing opportunities.
- PET bottles can be transparent or any other colour including white – which reduces the effect of light on milk.
- Smooth, esthetic finish of the bottles neck, formed during preform injection – no knife cut-off trace or spikes like in a HDPE.
- New generation of cap closure dedicated for PET bottles that prevents contamination of the product in case of multiple use (repeated opening and closing).
- PET is extremely lightweight and has a high shock-resistance. It’s convenient for production and distribution. Transport in several layers is possible – up to six layers with the right bottle design.
- Positive environmental profile PET can be easily recycled.
- Like glass, PET is a biologically inert material that doesn't react with beverages or foodstuff and is resistant to attack by micro-organisms.
ADVANTAGES OF THE COMPLETE LINE OFFERED BY SMF

Professional advice and service from one contractor design, engineering, and equipment across the line.

Warranty and post-warranty service 24 hours / day.

Turnkey solution, adapted to the customer's requirements.

High efficiency of OPTIMA blowing machine up to 28 800 BPH.

Full automation of all sections of the production line i.e. blowing, filling, labeling.

Aseptic filling provided by NON-CONTACT valves.

Use of high quality materials.

ULTRA CLEAN version of TRIBLOCK providing protection against bacteria.
CHAPTER I

STAGES OF PREPARING
THE ESL MILK
FOR BOTTLING
ESL (Extended Shelf Life) Milk is fresh milk with an extended shelf life.

**STAGE 1**

Milk is delivered daily to the dairies, due to the high content of microorganisms in milk, it is necessary to use refrigerated storage. Milk is cooled and maintained at temperatures 4 – 8 °C in special aseptic tanks.

**STAGE 2**

Cooled milk is filtered. Thanks to applying accurate biological filters the milk is free of bacteria cultures. Filtration positively affects the purity of milk.

**STAGE 3**

A homogenization is the next stage of milk processing – it is a mechanical process in which the milk is pushed under high pressure (up to 400 atmospheres) through a device called homogenizer, reducing the average diameter of fatty pellets and increasing their amount (after the homogenization maximum Ø of fatty pellets is up to 2 µm).

Fat is evenly dispersed. This prevents the cream from separating from the rest of the liquid once the milk is stored, milk has a better look and taste.

**STAGE 4**

After homogenization the milk is pasteurized at a temperature of 124 °C in ESL technology for about 4 seconds no longer (so-called endurance). These are sample parameters and depend on the applied production method. This process eliminates the activity of the enzymes catalase and pero-oxidase, and leads to extinction of pathogenic micro-organisms, keeping taste and nutritious properties.
The ESL milk differs from products existing on the market – the difference is a result of the technological process. Microfiltration process - a natural method of purifying and short-time pasteurization assure ESL milk to maintain nutritional value and taste. Provided high microbiological purity results that the ESL milk does not require a treatment at high temperature.

**STAGE 5**

After pasteurization, the milk is pumped into an aseptic tank and a constant cooling temperature of 4 to 8 °C is kept.

Milk cannot be infected*, because it is pumped by fully aseptic valves, with an additional cushion/airbag keeping a constant pressure in the tank during pumping.

*Most frequent milk infections are those from the contaminated installation where most of the bacteria accumulates causing the creation of mold.

**STAGE 6**

Milk from the aseptic tank is delivered directly to an aseptic filler. In order to maintain sterility the air, which is used, is purified by biological filters. The filling machine is equipped with a clean room with overpressure of cleaned air inside. This is achieved by the use of fans with HEPA filters (High Efficiency Particulate Air Filter).

**ADVANTAGES OF THE ESL MILK**

- High quality thanks to special care in every stage of the production process.
- ESL is a production process for obtaining milk with an extended shelf life. This method prolongs shelf life of the milk behind the period provided by traditional pasteurization.
- Microfiltration technology removes microbiological pollutants and reduces the contamination of bacteria in raw milk by 99.99%.
- ESL milk has a shelf life of 21 days when stored at temperatures up to 8 °C, convenient for distributors.
CHAPTER II

COMPLETE MILK BOTTLING LINE OFFERED BY SMF – ULTRA CLEAN VERSION
STRETCH BLOW MOULDING MACHINE FOR PET BOTTLE PRODUCTION

OPTIMA SERIES BLOWING MACHINES TECHNICAL PARAMETERS

<table>
<thead>
<tr>
<th></th>
<th>Optima 4 turbo</th>
<th>Optima 8 turbo</th>
<th>Optima 16 turbo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of mould cavities</td>
<td>4</td>
<td>8</td>
<td>16</td>
</tr>
<tr>
<td>Bottle capacity</td>
<td>0,25 – 2,5L</td>
<td>0,25 – 1,0L</td>
<td>0,25 – 1,0L</td>
</tr>
<tr>
<td>Output</td>
<td>up to 7200 BPH</td>
<td>up to 14 400 BPH</td>
<td>up to 28 800 BPH</td>
</tr>
<tr>
<td>Power installed</td>
<td>100 kW</td>
<td>160 kW</td>
<td>320 kW</td>
</tr>
</tbody>
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OPTIMA SERIES ADVANTAGES

- fully electric
- 30 – 50% less energy used per a blown bottle
- direct bottle discharge
- compact size
- use of servomotors
- high efficiency ceramic oven
- low energy consumption
- output over 1700 BPH per one cavity
- precise clamping unit with toggle system
- equipped with innovative technologies

DOUBLE STAGE PRODUCTION PROCESS

OPTIMA is the machine that uses double stage production process. The first step is the preform production with the usage of PET injection machines. Because of high cost of injection machines, preforms are usually delivered by external supplier. The final package (bottle) is being made during the stretch blow moulding process with the usage of PET blowing machines like OPTIMA. It is the second stage of the whole production process:
1. Preform thermal softening with the usage of special oven.
2. Blowing mould opening (by closing unit) and loading of heated preform.
4. Bottle forming with the usage of high pressure air blowing and stretch bar.
5. Mould opening and ready bottle transport to exit conveyor.
6. Bottle prepared to transport to the filler by air conveyor (or other).

**OPERATIONAL UNITS**

**DESCRIPTION**

**1. TILTER**

The machine is designed to automatize the production process. Thanks to this solution preforms are placed into the preform hopper automatically.

**2. PREFORM LOADING SYSTEM**

It is independent mechanical unit that consists of a preform container (hooper), a transport belt (conveyor) and a preform orientator. Its function is to load preforms from the hopper to the gravity rails. Preforms come from the container and are thrown on rollers of the orientator. Then orientated preforms are placed on the rails that transport them directly to the machine (point B).

Preform container is equipped with sensors that inform about the level of preforms. The volume of the hopper enables continuous work of the machine.

**3. GRAVITY RAILS FOR PREFORMS FEEDING**

Directly from the orientator, preforms are placed on the gravity rails which transport them to the machine, to the “loading star” of the machine.
4. "LOADING STAR” AND PREFORM TRANSPORT CHAIN

"Loading star" moves preforms from the rails to the place where they are loaded on the pins of the transport chain. Preforms are caught by internal holders of pins and transported in the neck up position.

The "loading star" and transport chain are moved at the same time with the use of motor and belt transmission.

5. OVEN.

With the use of transport chain preforms are transported through the process of thermal softening in the oven. Even heating on the whole surface of the preform is ensured by rotation around its axis. Rotation is carried out with a cog that cooperates with the transport chain.

6. OVEN MANIPULATOR – PREFORM MOVING TO THE BLOWING SECTION

When the heated preforms get out from the oven they are taken from the transport chain by a manipulator.

Working cycle of the oven manipulator includes:

1) Taking off the preforms from the transport chain.
2) Placing the preforms in the right position related to the position of the cavities in the closing unit.
3) Delivering preforms to the closing unit manipulator.
7. “COOPERATION POINT” OF OVEN AND CLOSING UNIT MAINULATORS

In this place preforms collected from the transport chain are moved to the manipulator of closing unit which transports the preforms directly to the blowing moulds.

8. CLOSING UNIT AND STRETCH-BLOWING SECTION

The closing unit manipulator places heated preforms in blowing moulds. In the same time transport system based on manipulator moves the blown bottles to the exit conveyor. The operation of heated preforms loading and transport of ready bottles is periodical and takes place simultaneously (during one move of manipulator).

The cycle of opening and closing of the blowing moulds is controlled from the control panel. The operator can adjust cycle time and speed to current situation.

9. STRETCH-BLOWING UNIT

Stretching bars are driven by servomotors. This solution ensures high speed and precision of their work. Operator can regulate the power and speed of stretching bars on the screen of the control panel. Stretching bars (Ø 12mm) are made of stainless steel.

Blowing process with compressed air takes place with the use of special electrovalves. Incoming air is filtered before it comes to the bottle forming process. The machine can be also equipped with air recuperation system which enables recycling of compressed air and its second usage in the production process. It reduces workload of the compressors and saves energy consumption. Thanks to used solutions air recovery process is safe and easy to control.

10. READY BOTTLE EXIT CONVEYOR

When the bottle production process ends, ready bottles are moved to the exit conveyor. Construction of that conveyor enables direct connection into an air conveyor (or other).
TRIBLOC = RINSER + FILLER + CAPPER

I. RINSER

Disinfection of PET bottles
1. Blown bottle before filling is rinsed in order to remove any possible bacteria and mold spores.
2. A solution of water with ozone is injected to the thread and wall of the bottles, which are then turned into upright position.

Cleaning agents:
- water aerated with ozone from an ozone generator
- water with hydrogen peroxide (H₂O₂) – a 0.2% solution is most common (effective but more expensive method)
3. Obligatory rinsing with pure water takes place after cleaning.

II. FILLER

4. The next stage of the production is filling of the rinsed bottle.

5. Rinsed PET bottle is gripped and transported under the neck (neckholding system) to the filling valve, where aseptic filling takes place. It involves use of NON-CONTACT valves located just above the neck of the bottle but not in contact with the bottle*.

The milk is filled volumetrically (homogeneous product) directly into the bottle. The valves work at a constant pressure, which prevents foaming and spillage of milk. Once the specified capacity of milk is filled the valve automatically shuts off the product and the bottle is transferred to the capping machine.

* It is essential to prevent milk spilling on the bottle neckring, because it will cause bacteria and mold growth in a very short time after closing the container, spoiling the milk.
III. CAPPER

6. Caps from the main container are orientated and transferred to the little chamber with UV lamps for sterilization to eliminate all types of bacteria.

7. Sterile caps are transported one by one, placed on the bottles and twisted. Then bottles are placed on a plate conveyor and transported to the labelling machine.

8. Transported bottles are detected by sensor assigning the label to each one of them, then they are directed to the star where label is placed.

LABELLING MACHINE

9. Labelled bottles are transported on a plate conveyor to a packaging machine. They are grouped in batches (typically 6 pieces), wrapped with shrinking foil creating a multi-pack. Milk is ready for distribution and sale.

PACKAGING MACHINES
SMF manufactures different types of conveyors designed for complete requirements in a bottling line. Conveyors connect equipment and machinery in the bottling line, ensuring internal transport and continuous production.

1. Air conveyor

Air PET bottles conveyors are designed for transporting empty PET bottles between the PET blowing machine OPTIMA and the first section of the TRIBLOCK – RINSER.

Single bottles are transported linearly at high speed, held at the necks so there is no problem with stability. The line is equipped with adjustable guard-rail which enables work with different bottles design.

Air conveyor system is also equipped with damping exit which is opened pneumatically to eliminate defective bottles from production.

2. Plate conveyors

Plate conveyors are designed for transfer of filled bottles from TRIBLOC to labelling machine and to packaging machine.

All the conveyors may have single or multi-row construction, are available in straight and curve parts and provide horizontal transport as well as transport in an angle.

Both plate and air conveyor have a modular construction. They are easy to adapt to the variable and evolving infrastructure of the production line.
CHAPTER III

SUMMARY
1. OPTIMA – fully electric PET blow moulding machine, output up to 28 800 BPH (bottle 1.0L)

2. TRIBLOC (RINSER + FILLER + CAPPERS) Ultra clean version offered by SMF assures high hygienic conditions.

All machine parts are made from high quality materials that are suitable for contact with the liquid (milk) securing health safety and high resistance against corrosion, bacteria and mold spores.

The ULTRA CLEAN version also means that the machine has a clean room with overpressure of purified air inside. This is achieved thanks to fans with HEPA filters.

* it is also possible to use biological filters, which need to be sterilized once a week (effective and more expensive solution)

3. Labelling machine

4. Packaging machine

5. Palletizer

6. Conveyors

KEY ADVANTAGES OF SMF SOLUTION

- Usage of PET bottle – weight only 22.5g for 1.0l bottle
- More cost effective solution than HDPE packaging systems
- UltraClean standard – 21 days of shelf life when cold chain assured
- Complete solution provided by only one supplier
- Professional engineering advice
- Warranty and post-warranty 24h service