



INTERPUMP
PROCESS TECHNOLOGY

Range of the Machines



- - - High Pressure Homogenizers - - -



- - - Laboratory Homogenizers - - -



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■ Homogenizers



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Homogenization

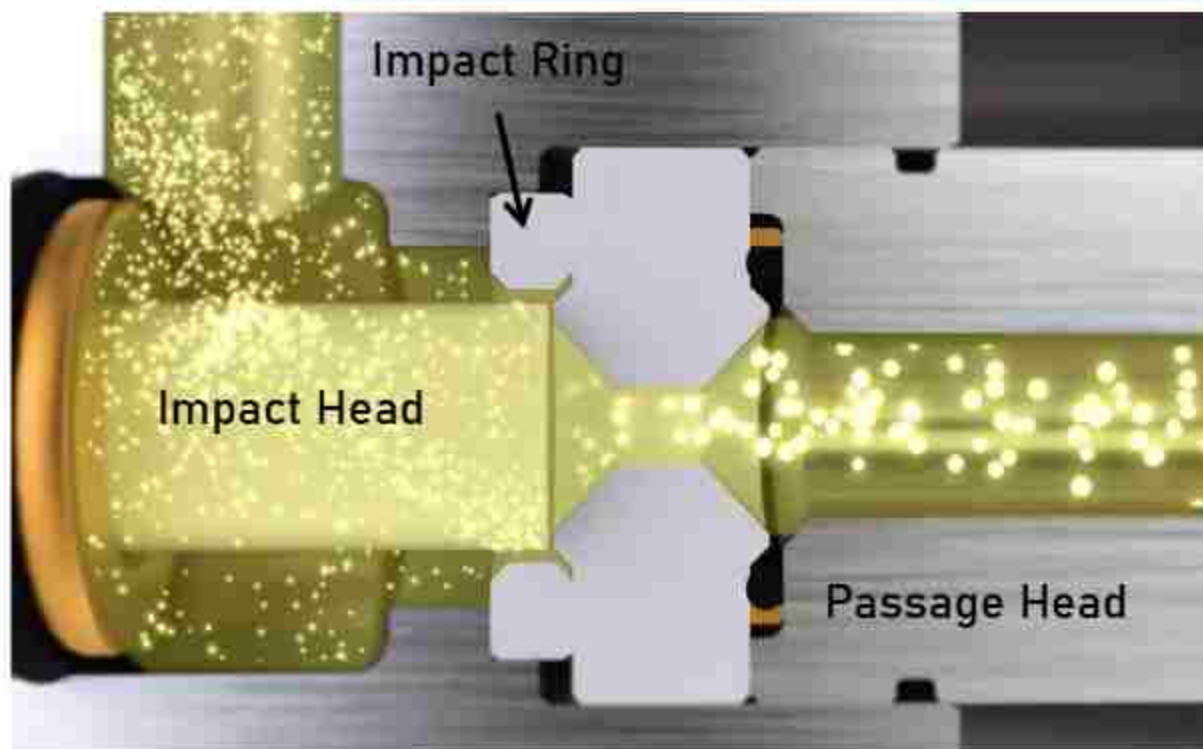
The principle is the particle size reduction, so the aim is to create:

- stable Emulsion fat in water
- fine Dispersion solid in water

Stable emulsion and fine dispersion are made by Micronization of Particles.

Flow dynamic condition at high velocity in gap between Impact Head and Passage Head generates micronization of particles up to μm or nm by:

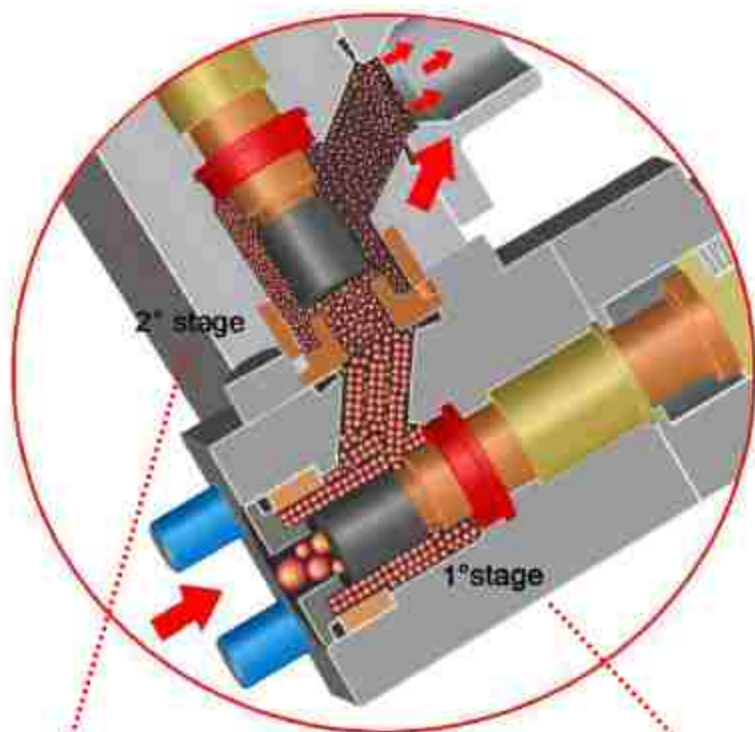
- Turbulence
- Cavitation
- Shear stress
- Impact



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Double Stage Homogenizing Valve



The particle reduction increases the separation time preventing floating and sedimentation.

The Second Stage is used to prevent fat clusters stabilizing the emulsion

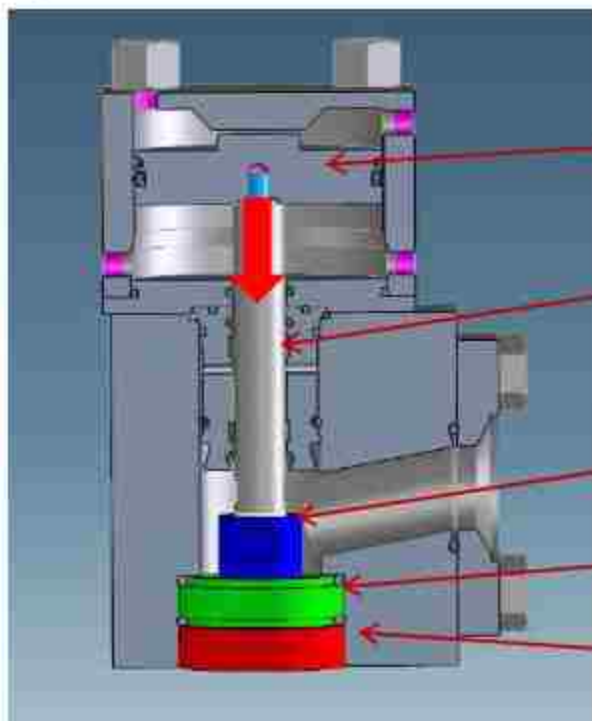
The first stage is used to micronize fat particles



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Homogenizing Valve Group



Pneumatic Actuator

Impact head Shaft

Impact Head

Impact Ring

Homogenizing Valve

Available material according to the application

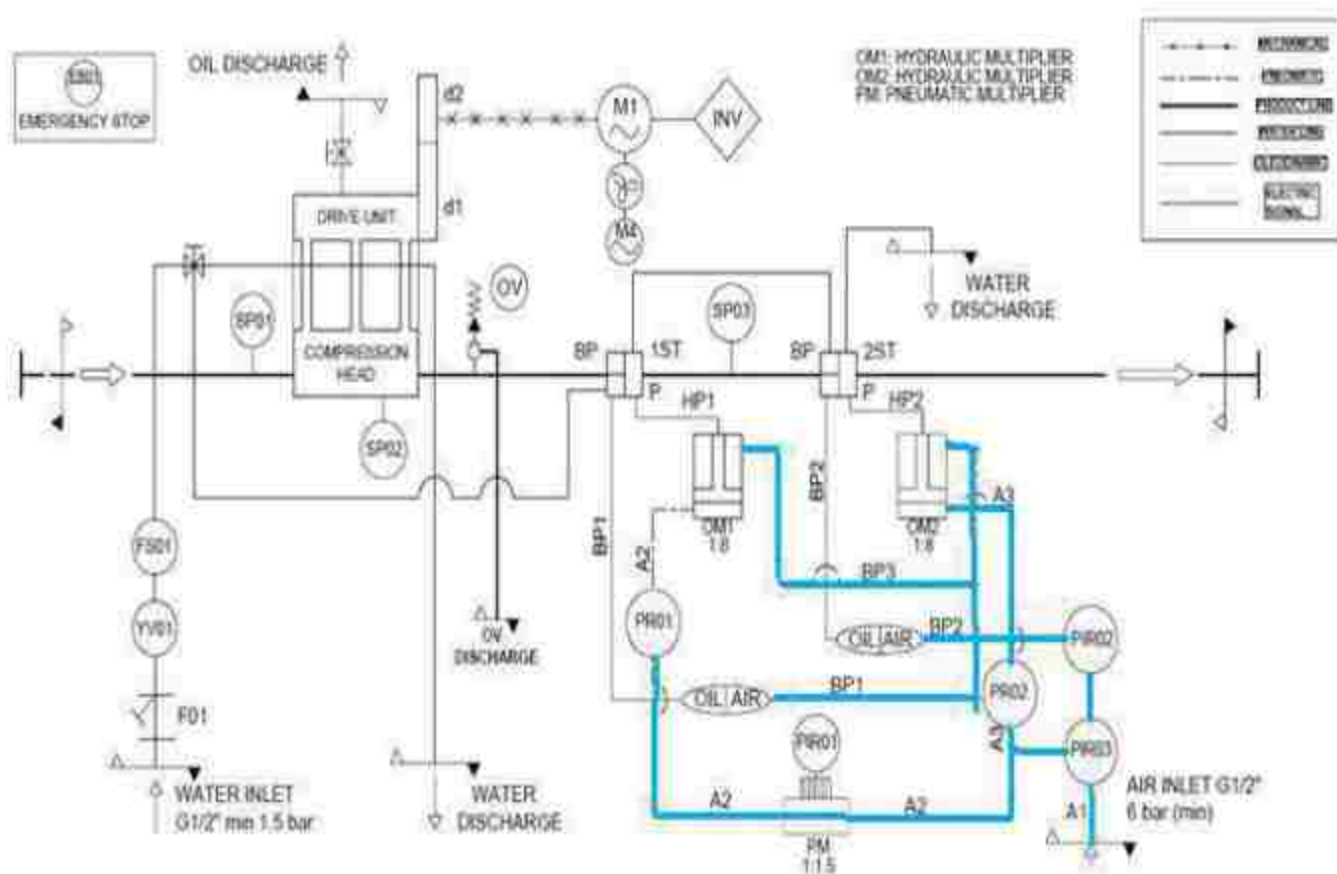
- ☐ Stellite 20
- ☐ Tungsten carbide
- ☐ Zirconia oxide ceramics
- ☐ Silicon Nitride



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Oil-Pneumatic System



The homogenizing group uses oil to uniformly transmit the homogenizing pressure to the homogenizing valve.

The air is needed to generate the homogenization pressure, while the oil generates the counter pressure

The air coming from the blue tube pushes the cylinder, which in turn pushes the oil, which uniformly transmits the counter pressure to the homogenizing valve.



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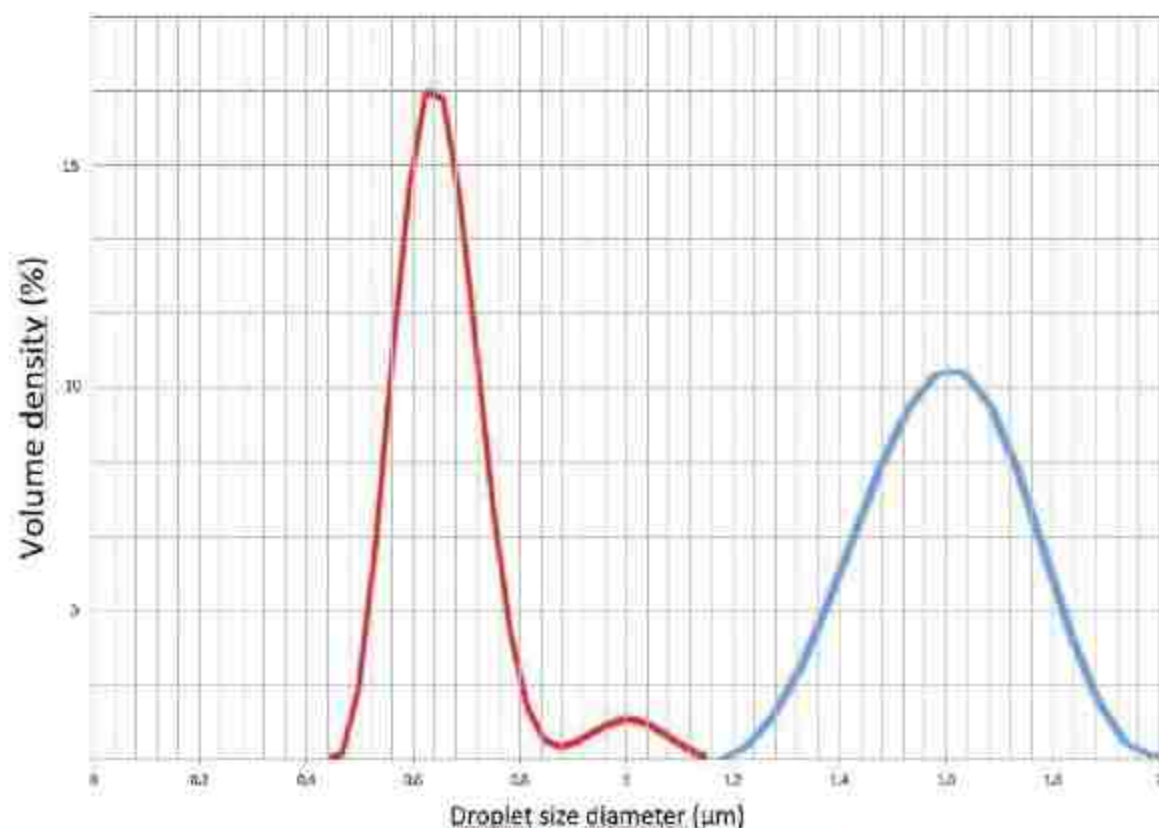


The Homogenization

The particle size reduction

Our laboratory is equipped with a laser diffraction particle size analyzer that gives an accurate particle size distributions for emulsions.

Here below a simplified example of cow whole milk Laser Particle Size Analysis, Mastersizer 3000.



RAW MILK Un-homogenized milk, average particle dimensions: 1,7 µm

200 BAR 200 bar, average particle dimensions : 0,63 µm (630nm)



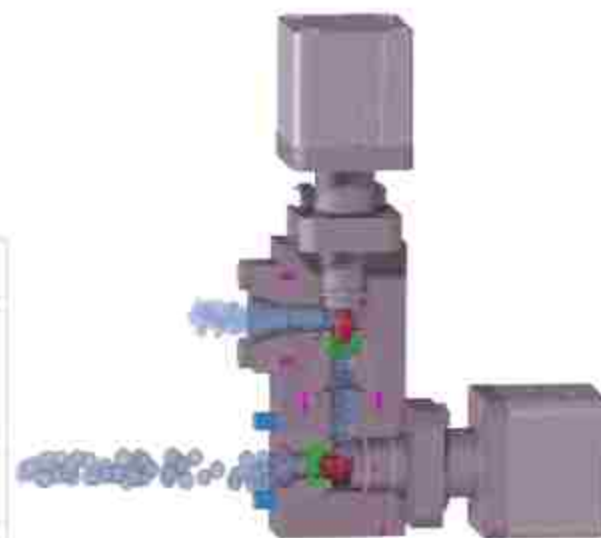
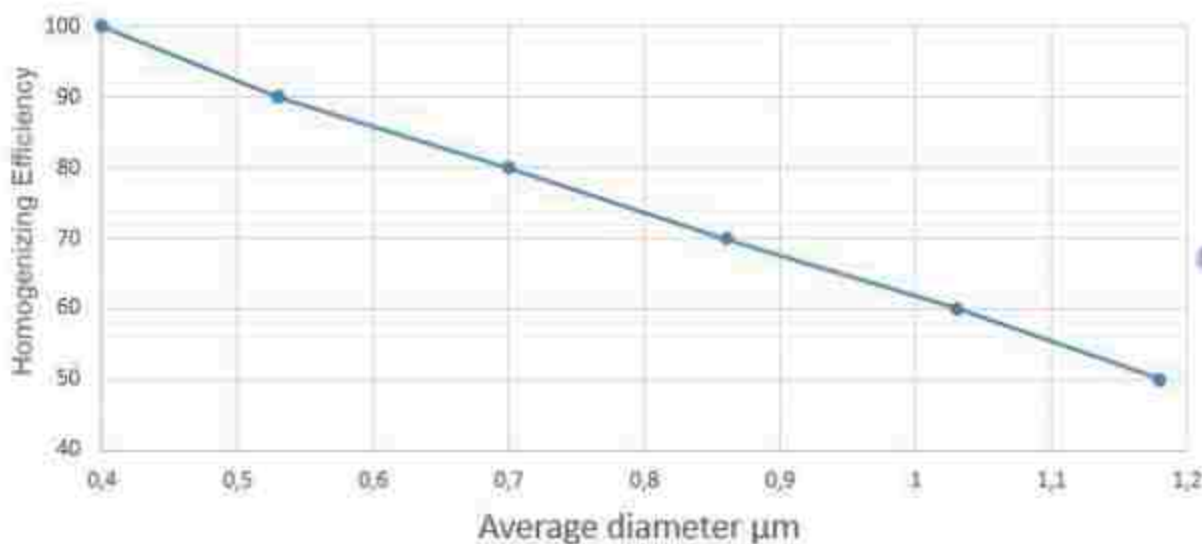
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The Homogenization Benefit/Pro

(cow whole milk example)

- ✓ Prevent fat floating for extended shelf lifetime
- ✓ Whiter and more appetizing color
- ✓ Taste improvement
- ✓ Minimized usage of emulsifiers and additives
- ✓ Better stability of milk products



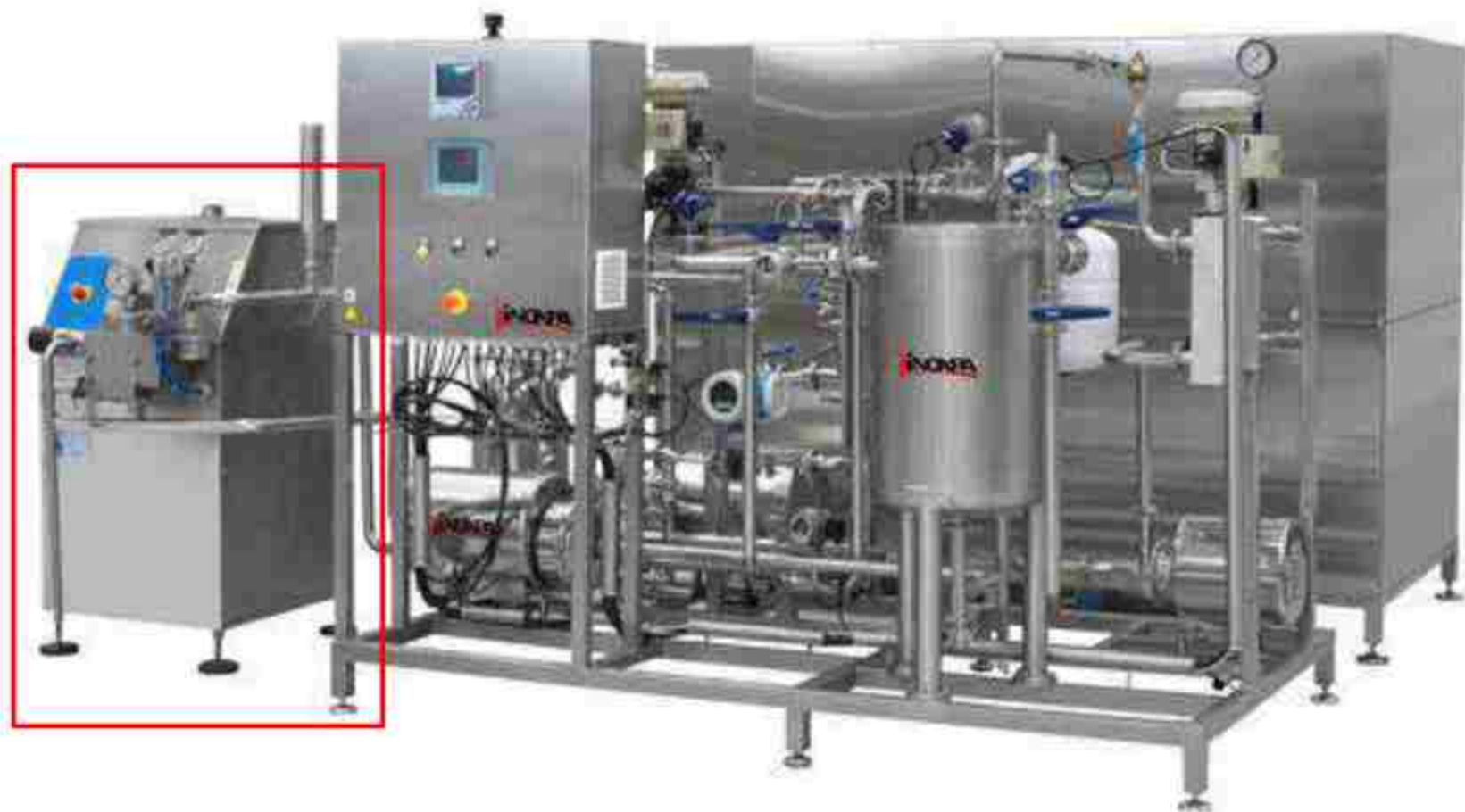
@200 bar, Average particle size with a dimension of 0,63 µm corresponds to NIZO efficiency %: 85



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Our Homogenizers



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Our Homogenizers

A Homogenizer is a machine that through the power and the shear stress of the piston pump can reduce particle size and creates fine dispersions or emulsions or cell ruptures and so on..

Here some of the applications in which is very useful:

Dairy: homogenized milk, yogurt, cream, fresh cheeses.

Food & Beverage: plant-based drinks (soy, oat), fruit juices, purees, sauces, UHT products.

Biotechnology: cell disruption, protein/DNA extraction, liposomes, cell suspensions.

Chemical: lubricant emulsions, pigment dispersion, paints, technical fluids.

Pharmaceutical: parenteral emulsions (Propofol), oral suspensions, nano emulsions, vaccines, liposomes drug system/carriers, injectables emulsions.

Cosmetics: creams, lotions, shampoos, conditioners, liquid make-up, sunscreens.

Nanotechnologies: carbon nanotube slurries, graphene dispersion, conductive nanomaterials, functional inks.



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Dairy

Some of our customers

DANONE

SORRENTINO
GRUPPO FERRERO

PINAR

Kraft

Arla

Juan
Valle

SANTA
CLARA

Amul

g
GRANAROLO

Unilever

Pascual

Nestlé

서울F&B

parmalat

LACTALIS
INTERNATIONAL

CAPSA FOOD

Plasmon

FrieslandCampina

서울우유



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Food & Beverage

Some of our customers



KAGOME



the best of fruit



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Tomato Reference

Some of our customers



tukas



KAGOME



SOLANA



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Eggs

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Pharma & Cosmetics

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L'ORÉAL



Kwality
Pharmaceutical Limited



Hansol



Paper



**FRESENIUS
KABI**
caring for life



ACS
DOBFAR
Spa



GE Healthcare



Fermentalg



Burc
A New World in Protein®

BIOCAD
Biopharmaceutical Company



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HOMOGENIZERS MODEL

Pressure bar	HA/PA 30	HA/PA 31	HA/PA 32	HA/PA 33	HA/PA 34	HA/PA 35	HA/PA 36	HA/PA 52	HA/PA 53	ATOMO 3.0
150	2.000	2.500	6.500	9.800	18.000	24.000	38.500	38.500	80.000	600
200	1.500	2.000	4.800	7.000	14.000	18.000	35.000	34.700	59.000	600
250	1.000	1.500	3.800	5.800	10.000	14.000	28.500	27.500	49.000	600
300	900	1.200	3.000	4.700	8.500	12.000	21.500	21.000	39.000	300
400	700	800	2.500	3.500	7.000	8.500	18.000	16.000	30.000	150
600	500	600	1.500	2.000	4.500	6.000	11.500	11.500	19.500	150
800	350	500	1.000	1.500	1.800	3.500	6.500	7.500	13.000	100
1.000	300	400	800	1.300	1.800	2.800	5.000	6.000	10.500	100
1.200	200	300	600	800	1.400	2.200	4.000	5.200	8.000	30
1.500	200	200	400	800	1.000	1.800	4.000	4.200	6.500	30

Machine Selection



Request example:

- Product: Milk
- Flow Rate: 10.000 lh
- Pressure: 200 bar
- Type of Flow: fixed or variable

Technical Performances HA/PA model 34

N.Plungers				3						
Stroke (mm)				108						
Max. load on the bronze bearing (N)				80.000						
RPM max at 500 mm/s - 420 mm/s				195	160					
Mechanical efficiency				0,95						
Volumetric efficiency	0,94	0,94	0,94	0,94	0,94	0,94	0,94	0,94	0,94	0,94
Pressure (bar)	25	50	75	100	130	150	180	200	230	250
Max. Plunger diameter installable (mm)	85	85	85	85	85	80	75	70	65	60
Max flow rate at RPM max	20.200	20.200	20.200	20.200	20.200	17.900	15.700	13.700	11.800	10.100
Theoretical Flow rate per rpm	1,83	1,83	1,83	1,83	1,83	1,62	1,43	1,24	1,07	0,91
Flow rate per rpm	1,72	1,72	1,72	1,72	1,72	1,53	1,34	1,17	1,01	0,86

Model	HA/PA 34
Flow rate (lt/h)	10.000
Pressure(bar)	200
Fixed or Variable speed	Fixed
Mechanical efficiency	0,95
Volumetric efficiency	0,94
Variable efficiency	1
Power consumption [kW]	62,2
Fill with q value, RPM	1,17 142,3

Model to be selected:
HA34075



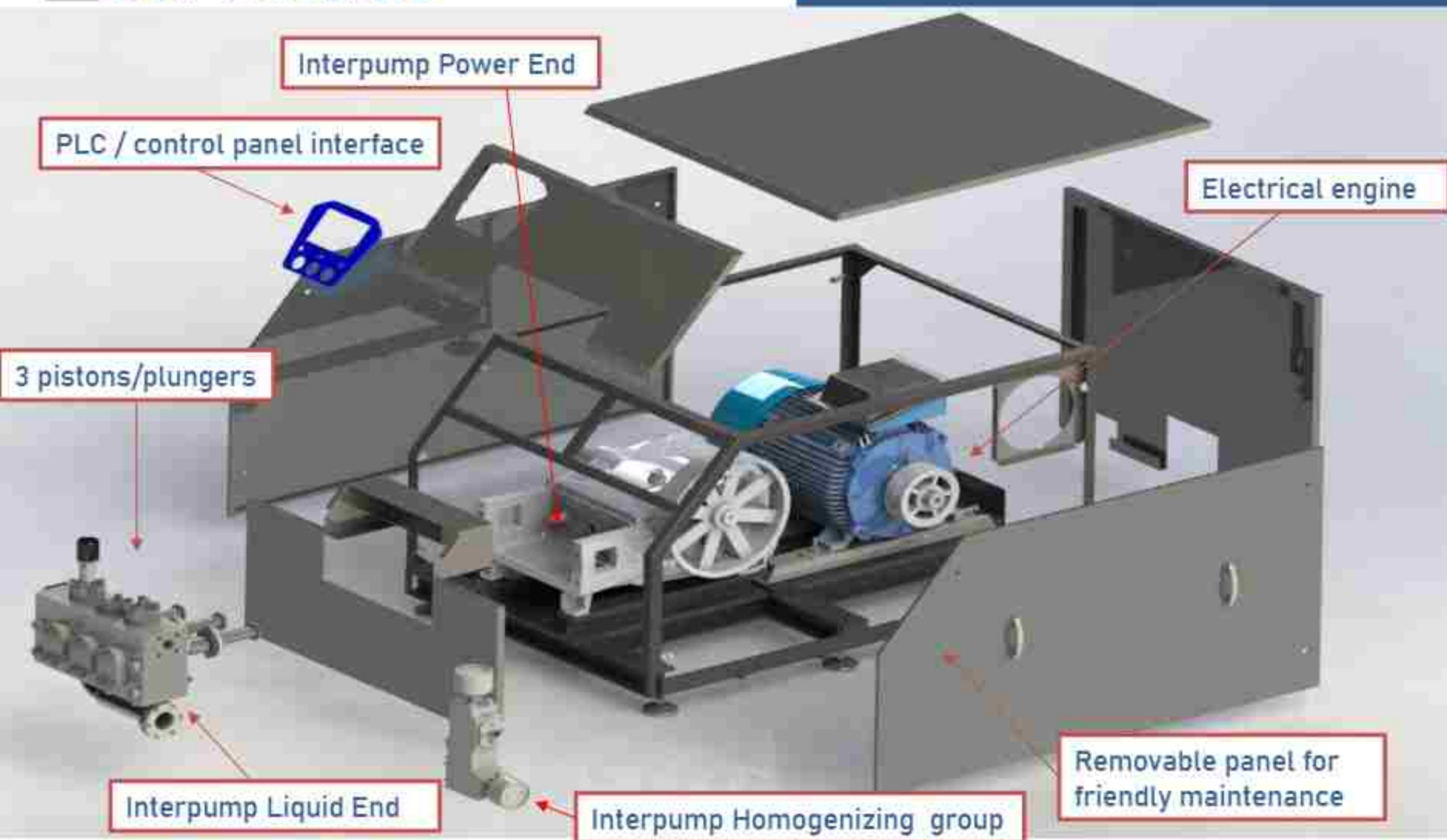
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■ EVolution Series



Our Machine



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Compression Head Materials

Standard DUPLEX Monoblock up to 600 Bar
made from SAF 2205

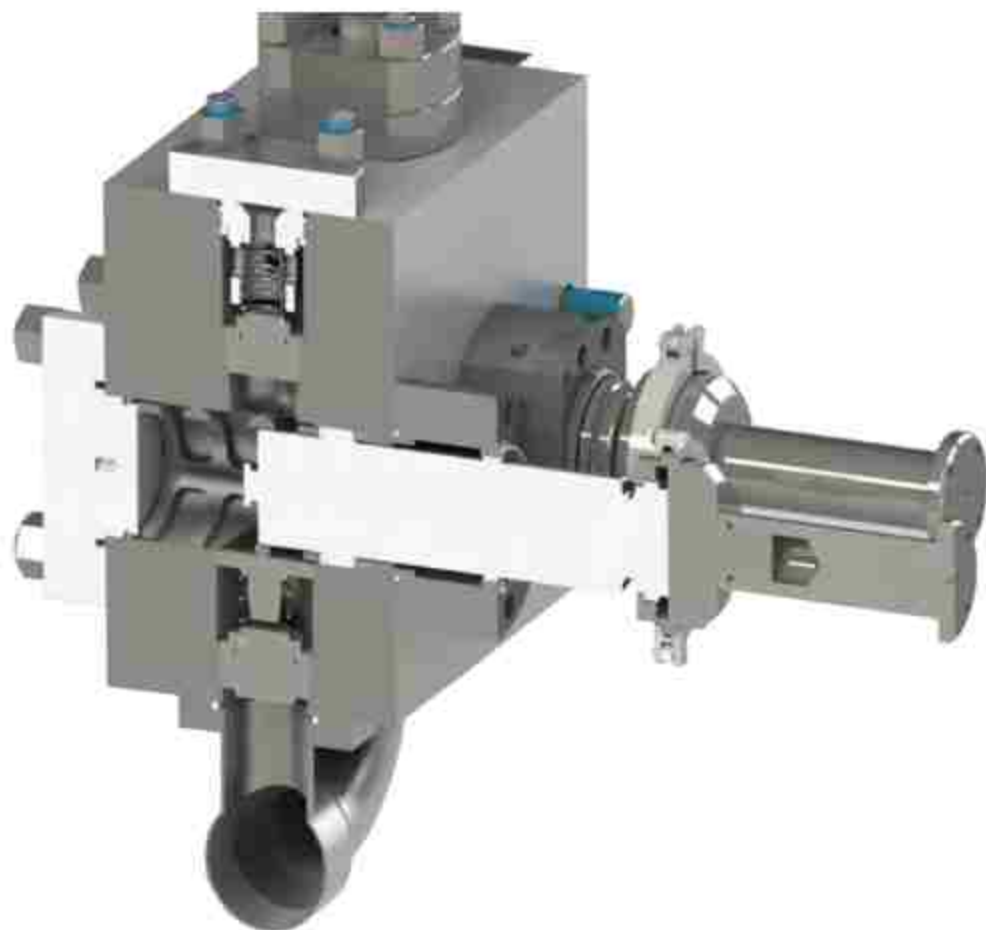
	STANDARD	ABRASIVE PRODUCT	CORROSIVE PRODUCT	HIGH TEMPERATURE/ ASEPTIC	PRESSURE > 600 BAR
SEAT	STELLITE 20	TUNGSTEN CARBIDE NICKEL BINDER	STELLITE 20	TUNGSTEN CARBIDE NICKEL BINDER	TUNGSTEN CARBIDE NICKEL BINDER
VALVE	STELLITE 20	STELLITE 20 (BALL)	STELLITE 20	STELLITE 20	STELLITE 20 (BALL)
GASKET	EPDM	VITON	VITON, KALREZ	EPDM, VITON	EPDM 85 SH, OR PU, VITON 90 SH
PACKING GASKET	NBR + COTTON	KEVLAR + COTTON	KEVLAR + COTTON, VITON + COTTON	KEVLAR + COTTON, HNBR + COTTON	SINGLE ELEMENT UHPWE
PISTON	AISI 630 CHROME COATED	AISI 316 + CHROME CARBIDE COATING	AL2O3 CERAMIC	AISI 316 + CHROME CARBIDE COATING	ALUMINA CERAMIC
COMPRESSION HEAD	MONOBLOCK FORGED DUPLEX SS	MONOBLOCK FORGED DUPLEX SS	MONOBLOCK FORGED DUPLEX SS	MONOBLOCK FORGED DUPLEX SS	MULTIBLOCK SUPERDUPLEX SS



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■ Plunger Self-Alignment System



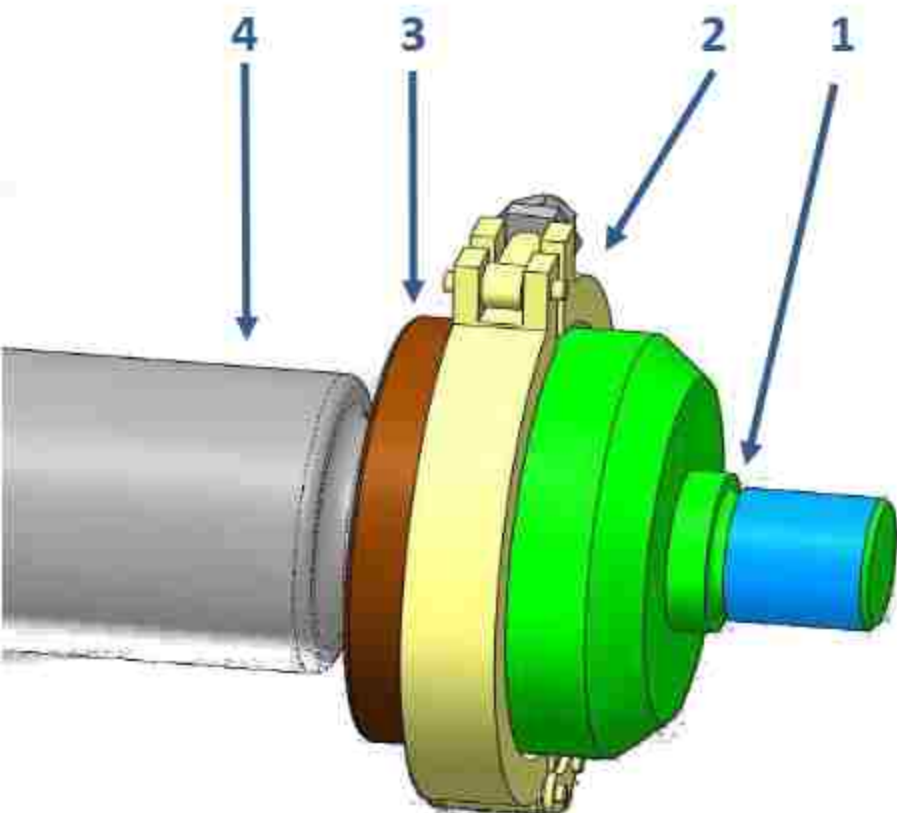
- ❑ Self centering plunger system – two peek washer guides located at equal distance to the plunger stroke to have a perfect alignment and zero deviation
- ❑ The combination of patented clamp and long arm between the washers reduces the lateral forces minimizing the wear of plunger and packing surfaces.



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Plunger Self-Alignment System



- 1) Connecting piston rod
- 2) Tri - Clamp connection
- 3) Flange
- 4) Plunger

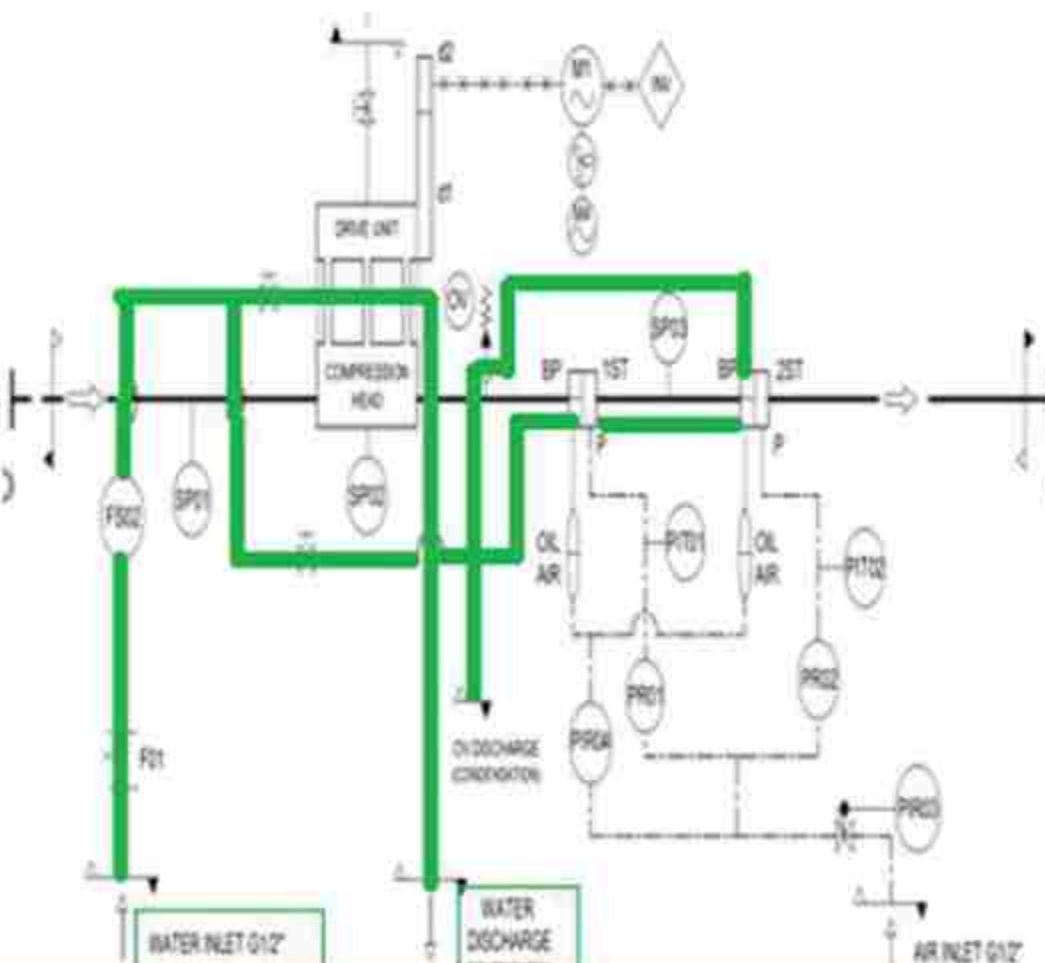
Patented system that extends the lifetime of plungers and packings. Lifetime of Chromium Carbide HVOF plungers over 20.000 working hours and Kevlar packing over 2.000 hours.



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Plunger Lubrication System



- Our lubricating water chamber to lubricate and cooldown the plunger without sprayed water in the sump
- Better lubrication/cooldown of plunger for extended life of plunger and packing
- Solenoid valve and flow switch always included



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Tungsten carbide coating and nickel chromium

This Plunger offer a proven surface corrosion resistance in combination with the robustness of metal plungers which are not subject to temperature shocks and brittleness of solid ceramic ones.

The surface hardness of the plunger and its resistance to scoring, peeling and corrosion.

THE MANUFACTURING PROCESS

A stainless steel AISI 316L (1.4401 / 1.4404) base plunger is coated with **hard material powder (tungsten carbide) printed on the plunger using a gun**, where high velocity and temperature gas stream is transporting to the plunger surface powder particles with high velocity and kinetic energy, **forming a coating with excellent bonding properties (HVOF)**. This process it is different to the Detonated™ process because it is used **nickel and chromium filler instead of epoxy resin that is suffering the corrosion of frequent CIPs.**



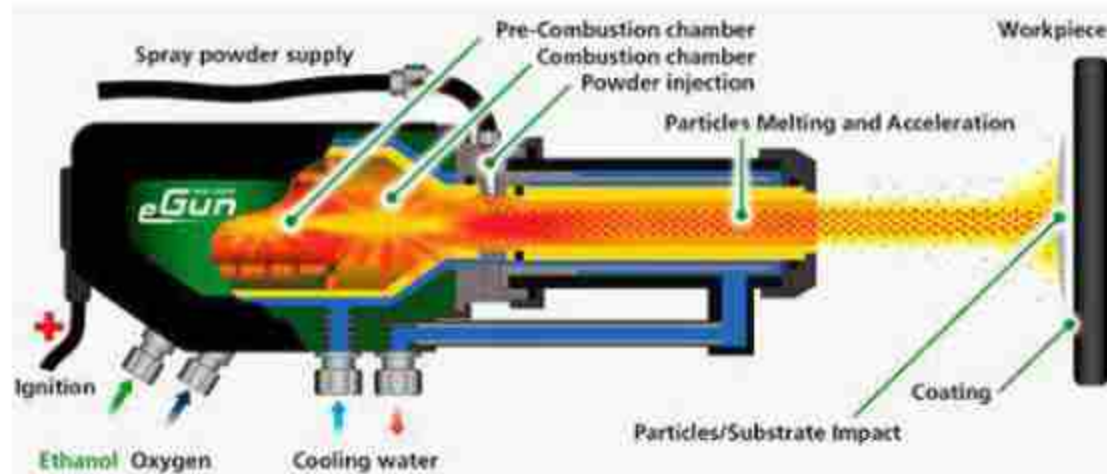
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Tungsten carbide HVOF coating and nickel chromium

THE MAIN FEATURES OF HVOF PLUNGERS

- Long lifetime over 16.000 hours on dairy application
- Low porosity for extended lifetime of plunger packing $Ra < 0.4 \mu m$
- Hardens 800 VH
- The HVOF plungers are with FDA approved for use in contact with food products.
- ++ Temperature Shock Resistance compared to solid ceramic and ceramic coated plunger
- ++ Corrosion Resistance compared to detonated plungers with epoxy resin or ceramic coated plungers



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■ Drive Unit up to 90 kW



- ❑ The Interpump Splash lubrication system doesn't need oil/water cooling
- ❑ No external gearbox weight on the crankshaft
- ❑ No additional electrical motor for lubricating unit = less energy consumption
- ❑ No additional oil pump, less maintenance cost
- ❑ Nitridized Crankshaft on all the models



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Drive Unit over 90 kW



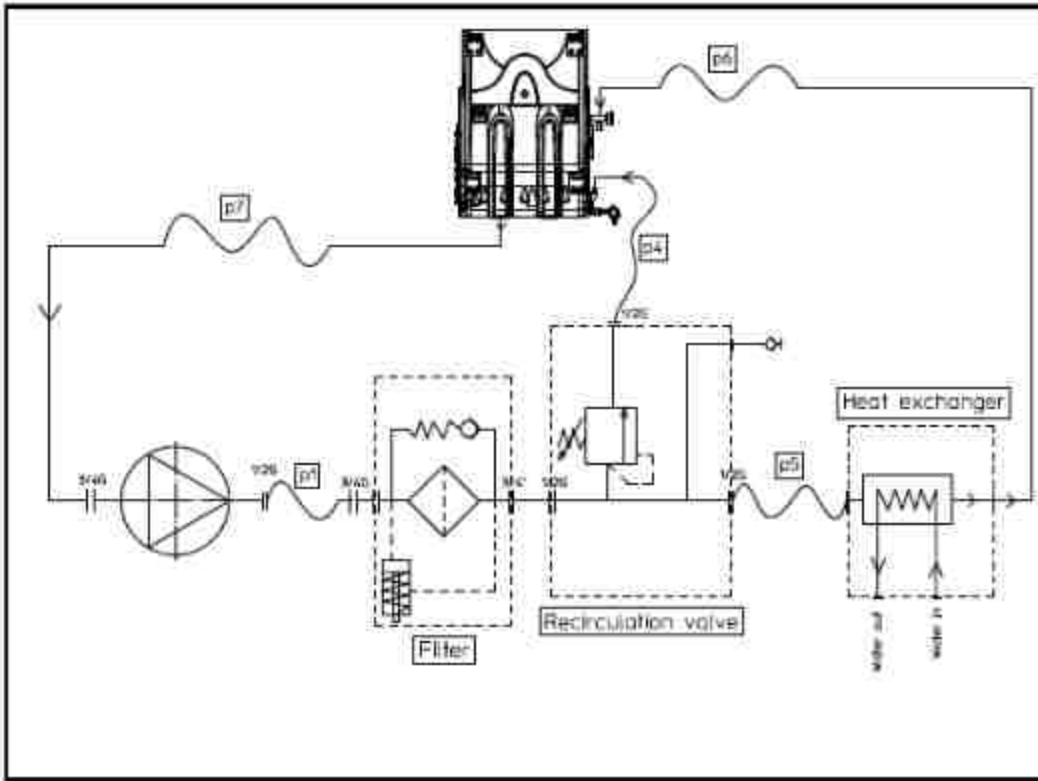
- ☐ No external gear reducer
- ☐ No gear reducer cooling = less water consumption
- ☐ Only one lubrication oil type
- ☐ No external gearbox weight on the crankshaft
- ☐ Nitrurized Crankshaft on all the models



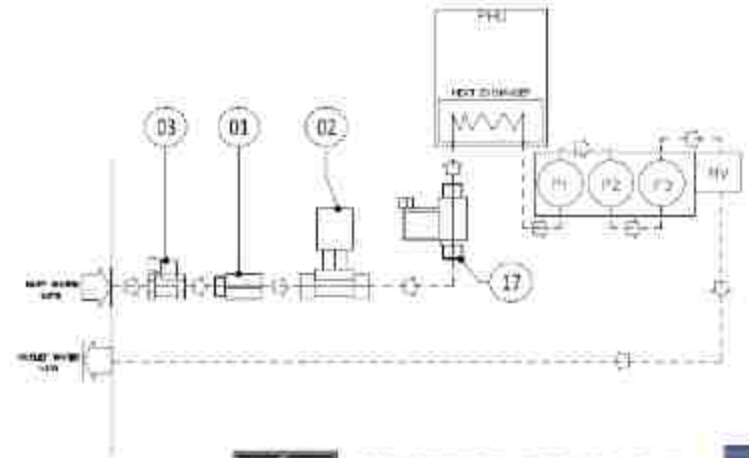
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Our Hydraulic System



- Up to 90 kW we install splash lubrication
- Over 600 bar, we install splash lubrication up to 30 kW
- Over and up to 400 kW it's necessary to install an oil pump, heat exchanger and oil pressure switch, managed by a control unit.



Our Aseptic Homogenizer



Aseptic barrier fluid manifold with needle valve for regulating the flow, by solenoid valve, Up to 90 kW, cooling water free.

- Stainless steel connection for the piston seals, in parallel and homogenizing groups and the Overpressure Discharge Valve
- The synergy with Interpump drive unit, means a saving of water and steam:
 - a. Water saving 750 m^3/y
 - b. Auxiliary plant energy saving 3.000 kWh/y (-1,5 tons CO₂)
 - c. Increment of mechanical efficiency 2,5 %
Saving di 3200 kWh/y (- 1,7 Tons CO₂)



Total 3,2 tons of CO₂ SAVED /y



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Ultra High Pressure Up to 1.500 bar



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■ Interpump up to 1.500 bar



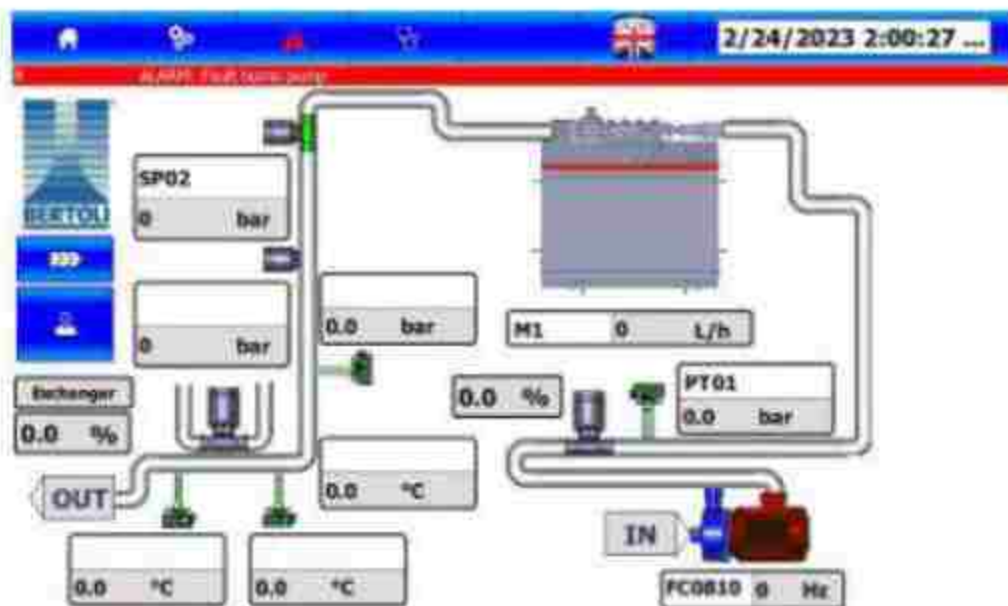
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Automation: PLC + HMI



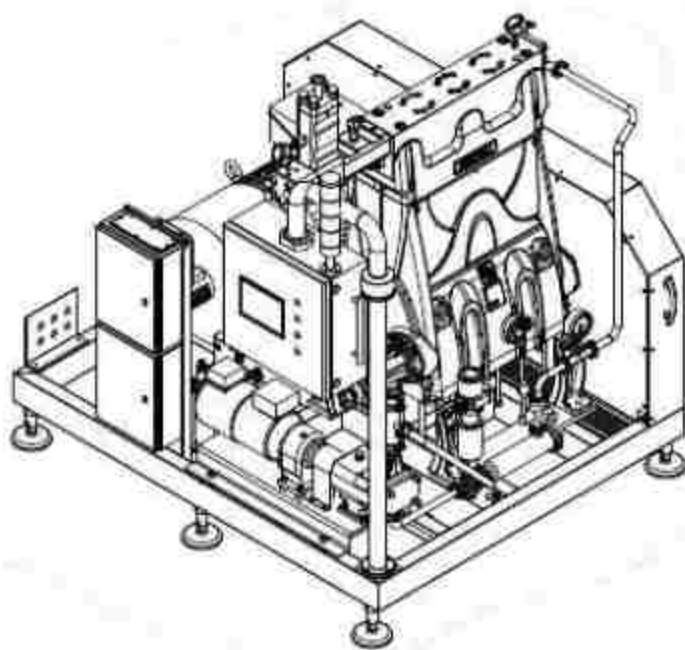
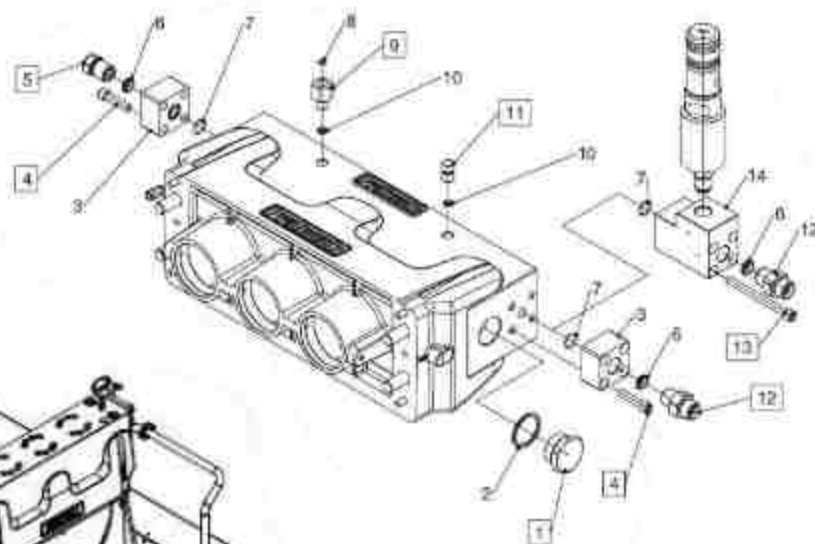
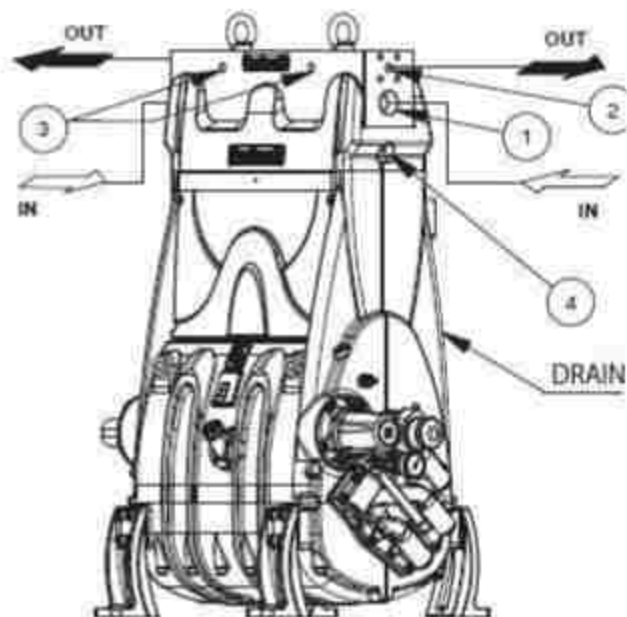
- Fully automated solution with PLC + HMI is available: Siemens S7 1200 is the standard,
- Communication protocol by: Profinet, Profibus or Ethernet,
- Alarms set point in accordance with customer request
- Audit trail supply, by usb or wlan



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Star Line Series



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Compression Head



Standard Ultra-High Pressure
made from Super Duplex
SAF 2507



- ☐ Pressure higher than 600 bar
- ☐ Low internal volume



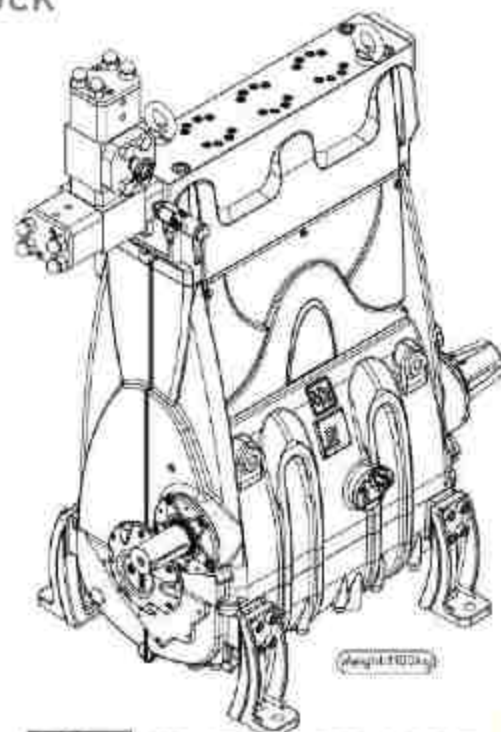
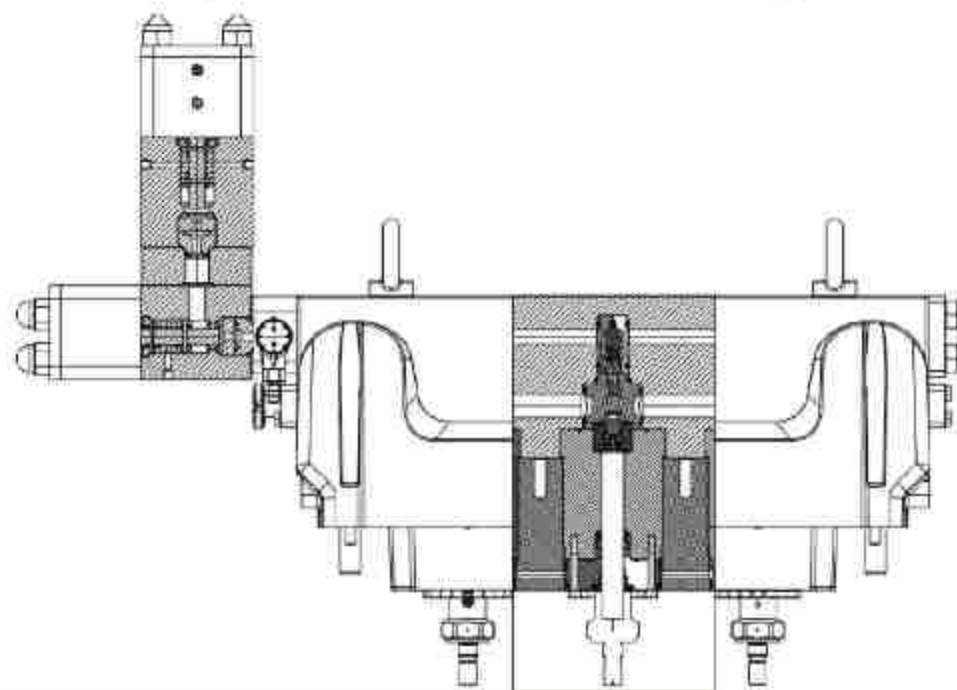
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Compression Head

From the world leader in ultra high-pressure application, a new design of compression head with:

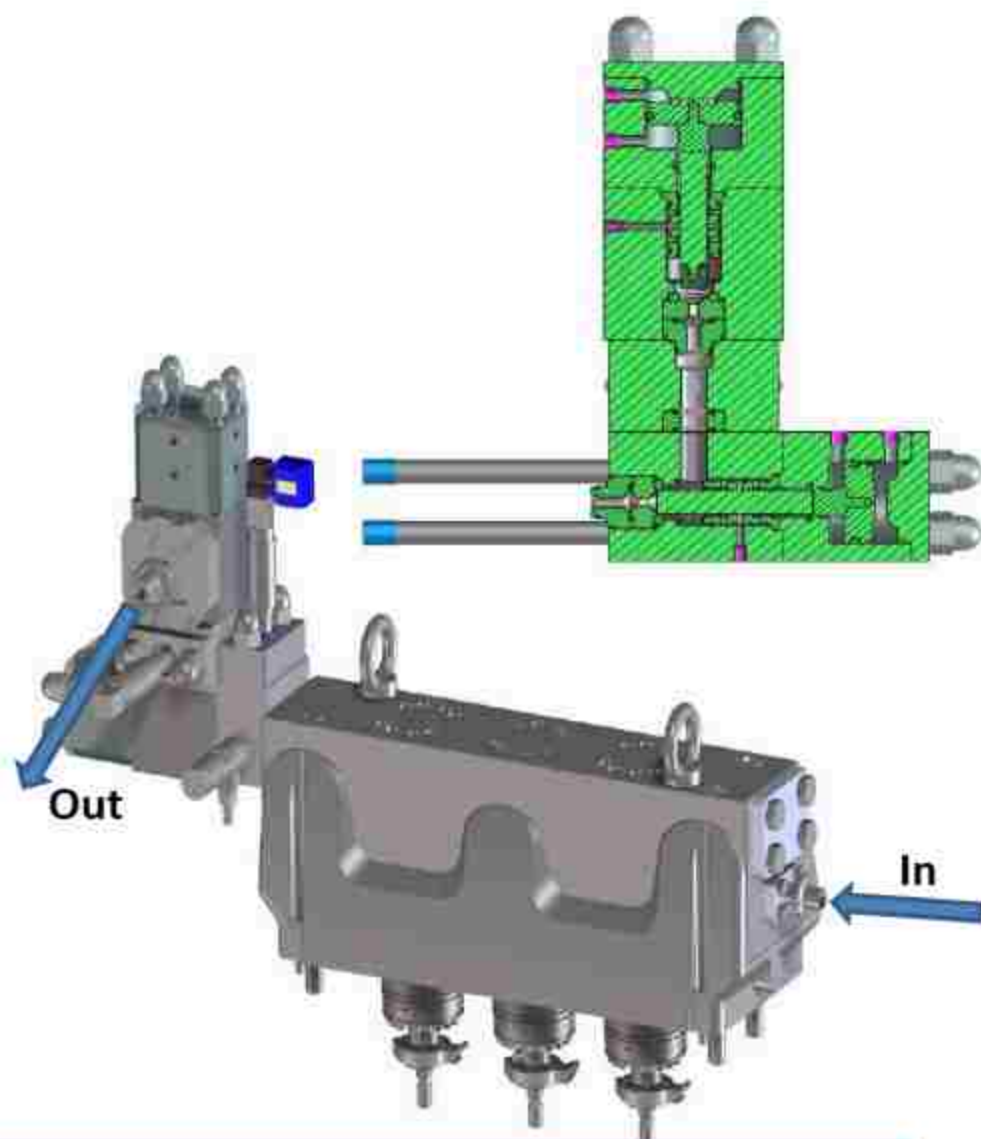
- ❑ Minimum dead volume – high volumetric efficiency
- ❑ Higher reliability (no T bore intersection in the compression head block)
- ❑ Minimum amount of material in compression head block (dramatically reduced sterilization time)



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SRV Liquid End



Liquid End

Low internal volume to increase the volumetrically efficiency and reduce the pressure load on mechanical parts.

Homogenizing valve made of zirconia oxide or silicon nitride.
Double stage available.

Pneumatic/hydraulic system to guarantee high and gentile force with smooth application of force on the homogenizing valve.

No cross-design increases parts lifetime and permits a better feeding with high viscous product.

Zero leakage at 1500 bar and zero cracks with less parts and less seals for reduced total cost of ownership.

Compression head mono-block made off Stainless Steel 17-4, shoot peened stainless steel compression head with high mechanical and corrosion resistance.



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SRV Liquid End features

Easy Maintenance

It's not necessary to dismount the compression head.

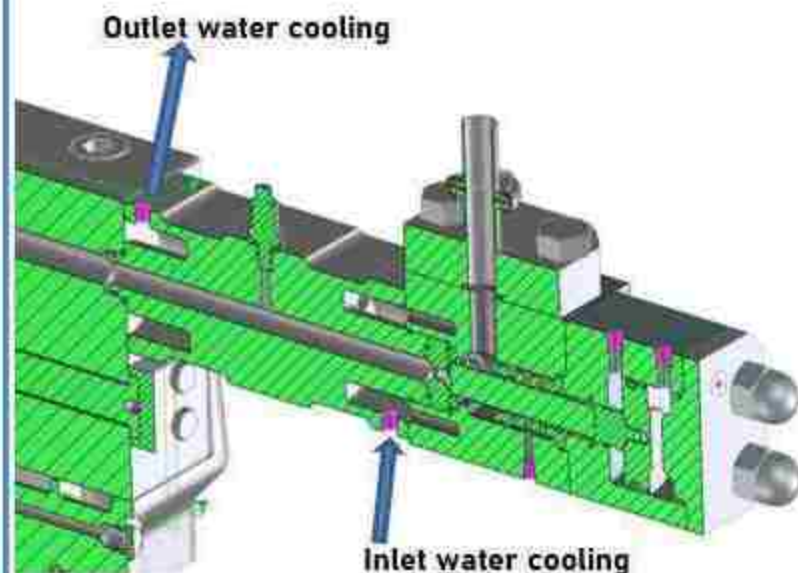
Piston packing can be replaced easily by removing the clamp connection and few studs.



Heating/Cooling

The homogenizing group can be heated/cooled by flushing the cooling plunger water on it.

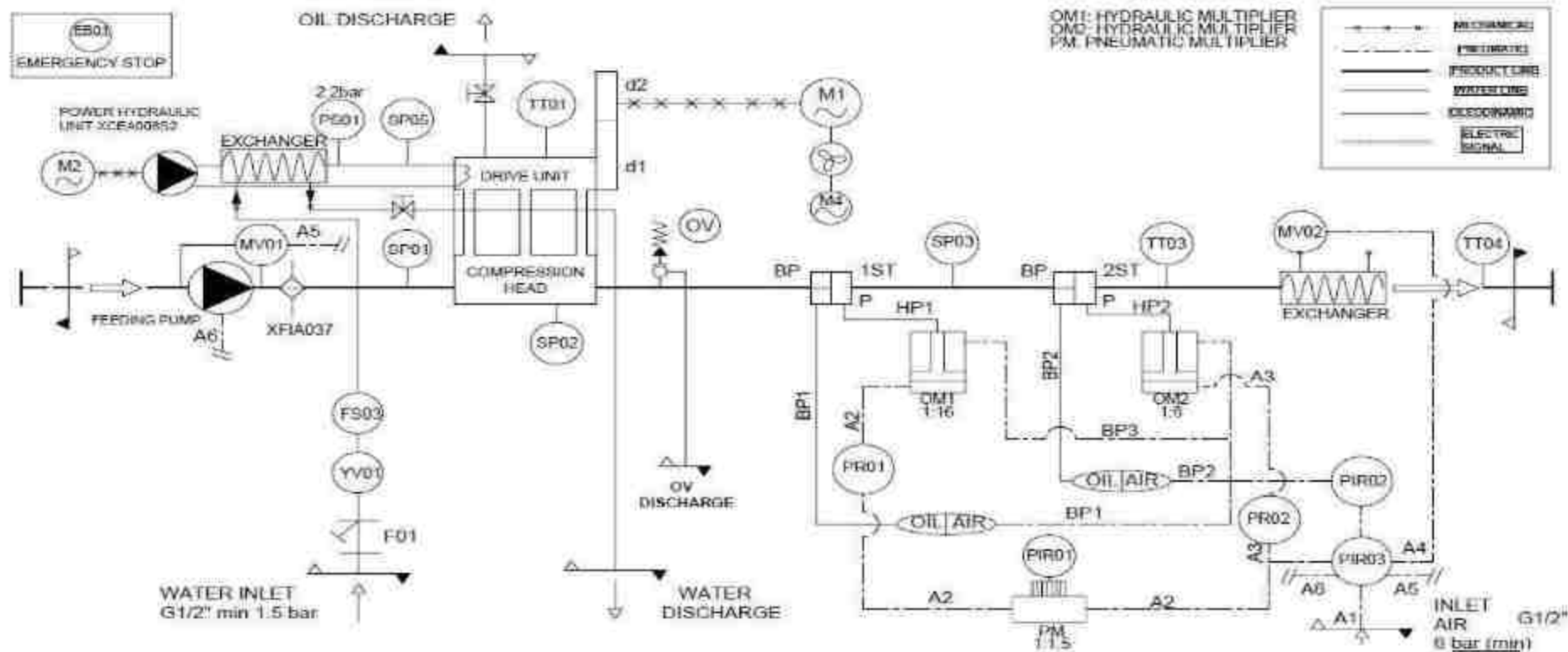
Temperature probes consent to check the product degrees.



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P&ID Skid Solution



1) MOUNTED ON THE FRONT SIDE OF THE MACHINE

2) MOUNTED ON THE PANEL BOARD

PRODUCT INLET	PRODUCT OUTLET	SAFETY VALVE
TO 1/10"	TO P	PRESSURE SETTING: 1500 bar

1 STAGE	2 STAGE
MULTIPLIER: YES	MULTIPLIER: YES
REGULATION: PNEUMATIC	REGULATION: PNEUMATIC
PIR01 = 0.3 bar	PIR02 = 0.3 bar
PIR01 = 0.12 bar - Set 0.3 bar	PIR02 = 0.12 bar - Set 0.3 bar
PIR02 = 0.3 bar - Set 0.3 bar	PIR03 = 0.3 bar - Set 0.3 bar
PIR03 = 0.12 bar - Set 0.3 bar	PIR04 = 0.12 bar - Set 0.3 bar

DIMENSION	FLOW CAPACITY	PRESSURE 1 ST	PRESSURE 2 ST	TEMPERATURE	VISCOSITY
MEASURE UNIT	lit	bar	bar	°C	cP
PRODUCTION	100-300 MAX 1000	MAX 1500	MAX 300	MAX 140	MAX 500
CLEAN/STERIL	MAX 1000	MAX -	MAX -	MAX 00	MAX -



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Highest Configuration



- ☐ Wetted Gaskets and Packings FDA compliant
- ☐ Wetted parts roughness $Ra < 0,6 \mu m$
- ☐ Sharp edge design for Homogenizing Valve
- ☐ Ceramic Homogenizing Valve and Plungers
- ☐ Certification Manual for pharmaceutical validation – CGMP and hygienic risk assessment documentation
- ☐ Factory Acceptance Test (FAT)
- ☐ IQ/OQ certification, SAT
- ☐ Option skid mounted units include inlet feeding pump, homogenizer and tubular heat exchanger
- ☐ Low temperature $-10^{\circ}C$
- ☐ Compression head design suitable for a clean room installation, additional HEPA filter
- ☐ Multiple passage for reducing particle dimension and Gaussian curve σ



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Laboratory Homogenizer

From LAB to production



Atomo 3.0

- It's equipped with homogenizing valves (1 or 2 stages) that replicates production scale models.
 - Combining three plungers flow pattern linked to the production models.
- This is the perfect scale up to the production application.



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Laboratory Homogenizer

From LAB to production

Product inlet in
the «Feeding
Hopper»



Only 28 kg !

Quark

- Equipped with 1-2 homogenizing valves replicating production models.
- Tabletop single plunger lab homogenizer for reliable tests.
- Syringe-feedable and collectable.
- Perfect fit for Pharma and new Food & Beverage R&D application
- Powered by torque motor and recirculating ball screw.
- VFD included.

- Minimized sample volume $\geq 10\text{mL}$



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Homogenizers: lab scale ATOMO 3.0

- The number of plungers of the homogenizer in your pilot plant it is more than a detail.
- The flow pattern is affecting on homogenizing result and on flow pattern in the process.
We keep always odd pistons to better compensate vibrations.

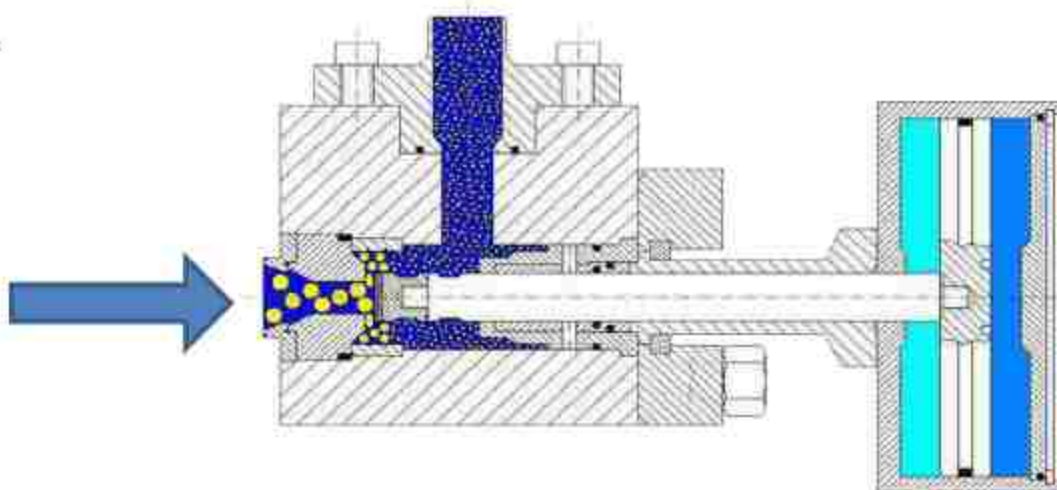
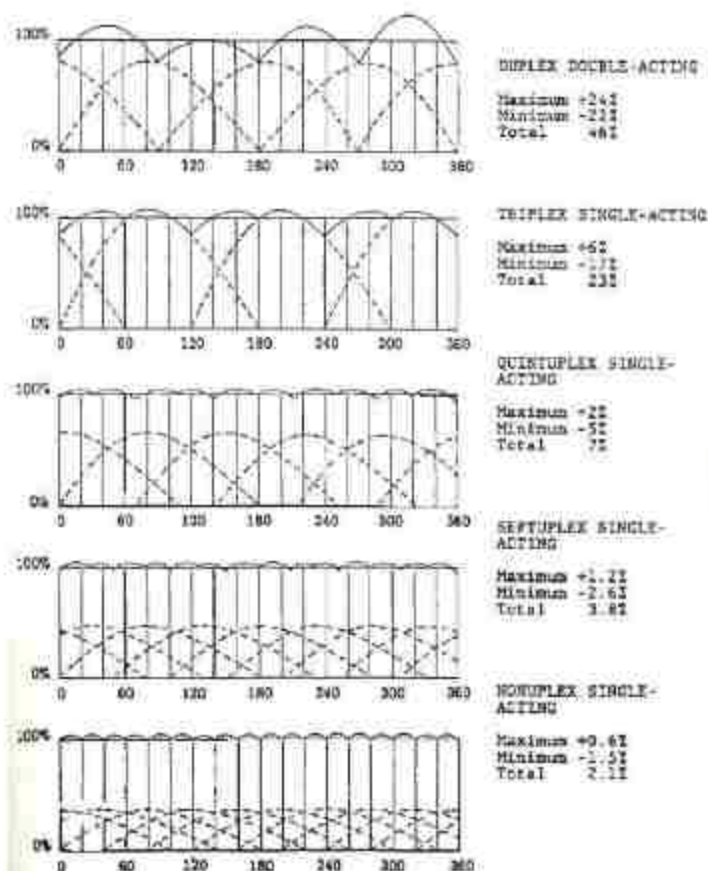


Figure 4.2. Discharge Flow Variations (Velocity) of Multicylinder Pumps.



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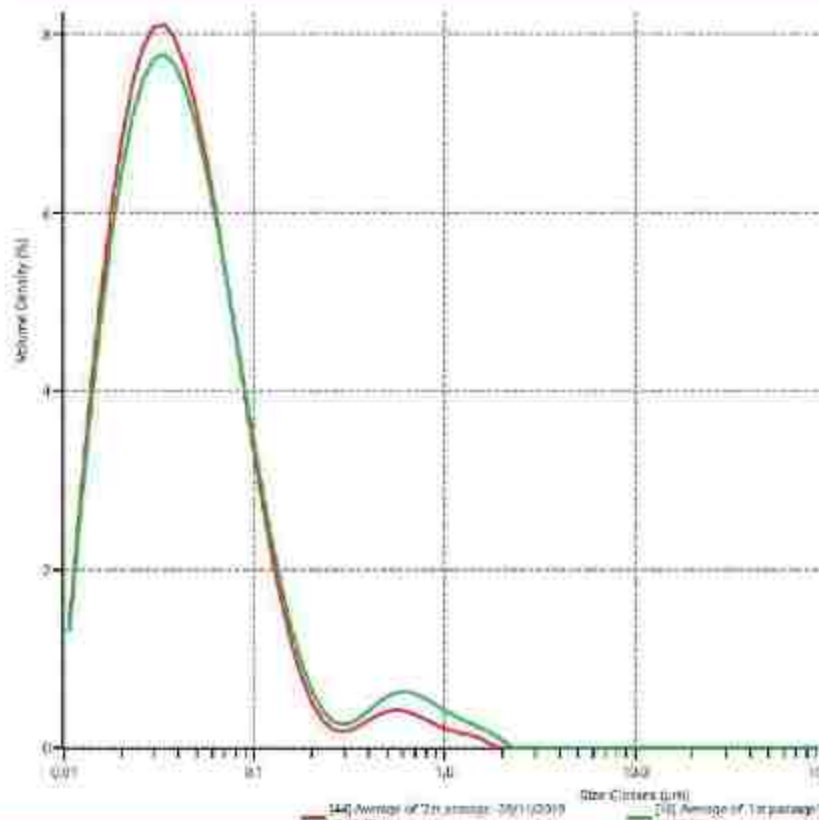


Bertoli Homogenization CNTs Results

The test with LAB 3 plungers ATOMO 3.0 shows:

- a particle dimension lower than $0,1 \mu\text{m}$ (100 nm) with just 1 passage @ 1.500 bar

(A SWCNT's length must be $<$ than $10 \mu\text{m}$ and thickness $<$ of $5 \mu\text{m}$ to avoid their agglomeration)



1 Passage at 1.500 bar

Dv 10	0,0165 μm
Dv 50	0,0391 μm
Dv 90	0,127 μm

2 Passages at 1.500 bar

Dv 10	0,0162 μm
Dv 50	0,0372 μm
Dv 90	0,107 μm



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A close-up photograph of a person's chest and shoulders. They are wearing a dark-colored polo shirt. On the left side of the chest, there is a logo in light blue. The logo consists of the word "BERTOLI" in a large, bold, sans-serif font, with the word "HOMOGENIZERS" in a smaller, similar font directly below it. The person's hand is partially visible at the bottom left of the frame.

BERTOLI
HOMOGENIZERS

<https://www.bertoli-homogenizers.com/>