

The Macfuge logo features the word "Macfuge" in a dark blue, sans-serif font. A light blue curved line is positioned under the "u" and "g" characters, resembling a stylized smile or a wave. The logo is set against a white circular background that is partially obscured by a dark blue background on the left and bottom.

Macfuge

# SEPARATION SOLUTIONS

Company Presentation

# The Company at a glance

## SERVIZI INDUSTRIALI S.R.L.

Proprietary technology for high-speed centrifugal separation

Fully equipped quality testing room

Over Speed Bunker

Balancing and testing area

R&D Dept.

Supply chain of more than 250 sub suppliers



## MILESTONES

1897: first patent on rotating machinery

1987: Foundation of new co. Servizi Industriali

2007: Launch of the Brand MACFUGE<sup>®</sup>

2020: Join the Interpump Group

Today: More than 1.300 installations in 75  
countries worldwide

# The Group

## The Interpump Group

An Italy based international industrial manufacturing group:

World leader pump and fluid handling market

Listed on the Italian Stock Exchange (FTSE MIB and STAR)

More than 30 companies with subsidiaries worldwide

Manufacturing sites in US, Europe, China, India and Korea

## KEY FIGURES

Turnover € 2,5 billion

EBITDA: € 500 million

9.000 employees



# The product at a glance

## THE DISC STACK CENTRIFUGAL SEPARATOR

The centrifugal separator is a high-speed rotating machine that employs centrifugal force to separate multiphase streams.

It enables continuous separation of solid and/or liquid contaminants from the main fraction.

This technology is widely applied across various industries



## MAIN INDUSTRIAL APPLICATION

- INDUSTRIAL FLUIDS AND PROCESS WATER
- FUELS, LUBRICANT AND BIOFUELS
- CHEMICAL AND PHARMA
- FOOD & BEVERAGE

# The industries of reference

## EQUIPMENT FOR PROCESSING OR ANCILLARY USE

Many industries employ separators for a wide range of processes.

Separators are essentially technology designed to optimize the static settling process.

They can significantly shorten the required settling time required for a process, leading to various advantages as:

- Shorter process time
- Less space (small footprint compared to alternative)
- Continuous operation
- Filtration of fine solid (Up to 1  $\mu\text{m}$  mesh)
- Higher separation performance (impossible under natural conditions of gravity 1G)

## MAIN INDUSTRIAL APPLICATION

- **Power generation:** crude oil, fuel, lubes, produced water, etc.
- **Marine:** fuel, bilge water treatment, exhaust treatment, etc.
- **Industrial fluids:** Coolants, Lubricants, hydraulic oil, etc.
- **Refined vegetable oils:** soybean, seed, sunflower, etc
- **Crude and virgin oils:** EVO olive oil, coconut, citrus, etc
- **Biofuels:** HVO, SAF, biodiesel, ethanol
- **Chemical:** olechemicals, refinery derivatives, petrochemical
- **Animal fats:** Fish oil, animal fats, protein, egg yolk
- **Beverages:** Juices, Beer, Wine, etc.
- **Pharma and Biotech:** cellular product, bio-fermentation, vaccines, API
- **Extract and Ingredients:** starch, yeast, aroma, essences, etc

# The business approach



## Design to project

MACFUGE platforms and application features are the core for developing solutions both for one-off project or as a wide-ranging application portfolio.

Major innovations and new prototypes are launched and consolidated with a high success rate by a modular approach



## Matching plant and process requirements

Bridging the gap between the stand-alone equipment and the item's purpose, as per as per specification of end-uses or system builder. Within the battery limit of centrifugal separator, the scope of supply is enriched with accessories and executions according to customer's requirement.



## Validation

Well-defined procedures are established to refer the customer to the feasibility of a new process, the validity of a solution, and the quality and efficiency of the product. From lab analysis and pilot testing to investigations, or FAT and SAT to qualify the solution, clear parameters are always shared with the customer to openly measure performance.



## Installation and servicing worldwide

The job is successfully finalized once the unit is properly installed and running. As the product is delivered worldwide, Macfuge engineers and service partners are ready for commissioning, training, maintenance and follow-up.



## Open dialogue and after-sales support

To maintain and grow the customer value along the time, a single entry point of communication is offered to manage all the activities installation related: from delivery, to commissioning, from trouble shooting to situation monitoring



## Customer based and market follow up

Continuous follow-ups of running units and market players allows MACFUGE to propose improvements and suggestion to boost yields or reduce consumption, again with a partnership perspective.

# Macfuge Products and platform

## Available configuration

- clarifier, purifier, concentrator (skimmer)
- solid bowl, self cleaning

## Sizes

- bowl diameter class from 200 to 800
- bowl volume class from 3 to 80 liters

## Operative parameters

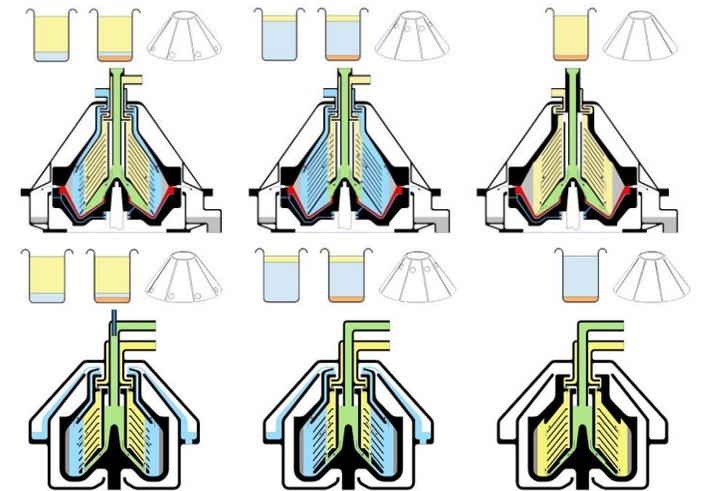
Capacities: from 50 to 1000 TPD

G force range: 8.000 to 12.000 G (bowl max inner diameter)

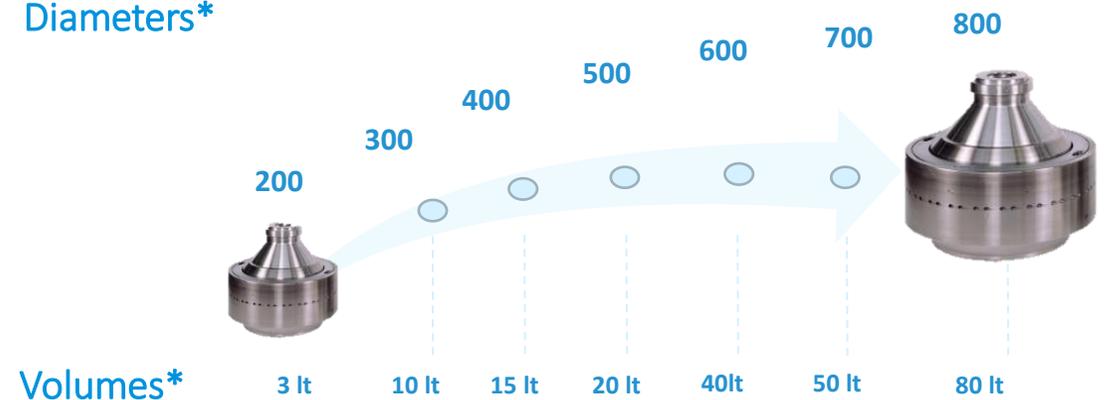
Area equivalent: from few thousands up to 500.000

scalability with  $\Sigma$  factor, Aeq, Kq within the range

## Configuration's scheme



## Diameters\*



\*Note: typical class of dimension

# Macfuge portfolio: models

MACFUGE 203	MACFUGE 181	MACFUGE 251	MACFUGE 306	MACFUGE 053	MACFUGE 105 / 106	MACFUGE 107
						
MACFUGE 260	MACFUGE 325	MACFUGE 450	MACFUGE 530	MACFUGE 590	MACFUGE 710	MACFUGE 830
						

# Macfuge portfolio: executions

## CORE TECHNOLOGY AND ACCESSORIES FOR OPTIMUM USE

Our proprietary technology is totally focused on the development of the centrifugal separator.

The centrifugal separator, in order to perform at its best, requires some operating conditions that can be achieved thanks to well proven accessories to be installed around it (e.g. heat exchangers, valves, pre/post filters, instruments, etc.)

Accessories can be supplied together with the centrifuge or provided by end user with MACFUGE control system ready for their installation and use.

In both cases it is advisable to be able to control temperature, pressure, capacity.

Vibration and rotation speed sensors are always provided by default.



# Macfuge “solid bowl” basic principle

The Macfuge separators “solid bowl” are useful for the liquid/liquid separation of mixtures containing no solids.

Centrifugal force and the settling effect of the disc surface are addressed to the continuous delivery of two liquid streams which are differentiated by their density: a lighter mixture (light phase) and a heavier one (heavy phase).

In absence of solid, all the space is utilized for the extension of separation surface, either by enlarged discs and higher disc number. Being not necessary moving part for solid discharge, the bowl is fashioned in a simpler way, more spacious and robust (solid bowl).

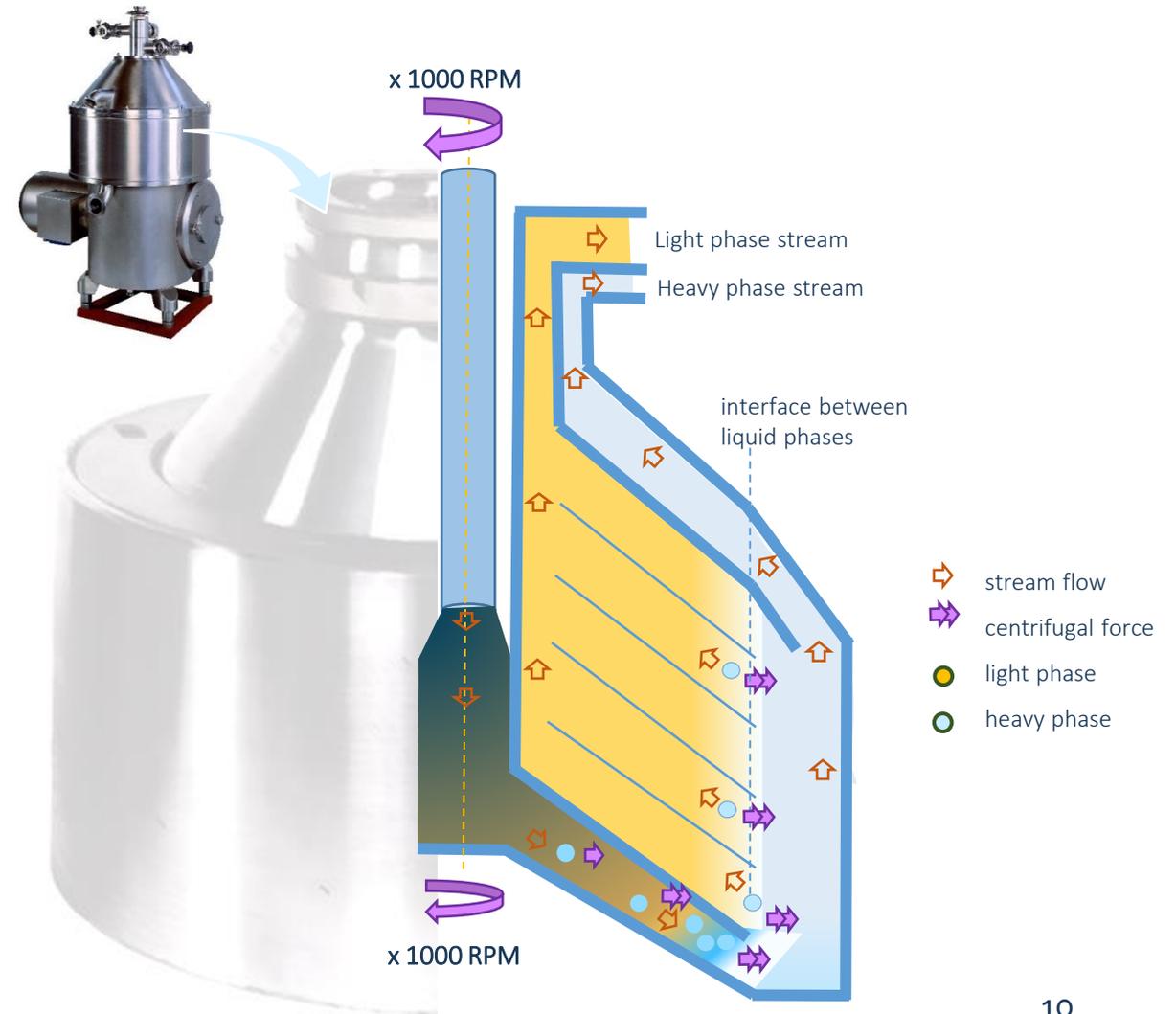
The design is intrinsically more safe either mechanically and in case of explosive and corrosive substance.

All together the Macfuge solid bowl are a competitive solution for liquid/liquid separation of mixture with increased requirement in terms of efficiency, corrosivity, safety, as for most of the cases in the chemical industry.

The Macfuge solid bowl can be optimized for each challenge: a combination of different material, against risk of dynamic corrosion (strong acid and chloride).

explosion proof components and nitrogen blanketing against the risk for explosive atmosphere.

These and other design features can be selected and combined once the separation duty and fluid characteristics have been designed.



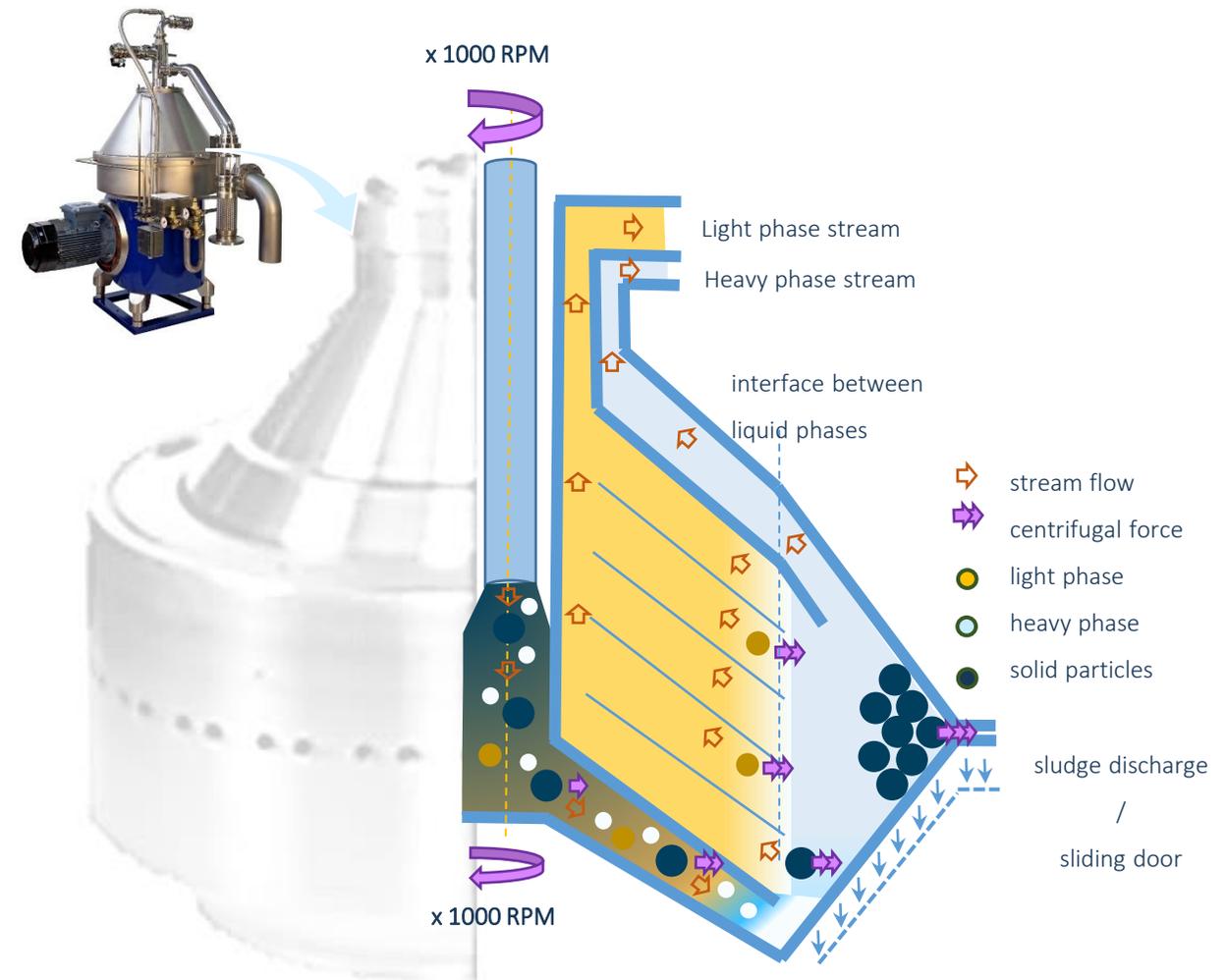
# Macfuge “self cleaning bowl” basic principle

The Macfuge separators generate a high centrifugal force to concentrate any solid impurity in the periphery of the rotating bowl, while continuously delivering two distinct liquid streams; one being a lighter mixture (light phase), the other a heavier one (heavy phase). A high number of conical discs, closely spaced, constitutes a high surface of separation (settling effect), magnifying the effect of centrifugal force, and making possible the separation of large quantities of product in the small volume space. The efficiency of separation depends from the correct choice of material and the drive capability to express high centrifugal force, from the discharging mechanism, and the correct geometry to maintain an optimum distribution of phases inside the bowl volume, and the handling of them.

Beside the configuration for general purpose the Macfuge offers design optimization for the various pretreatment challenges:

- special disc setup and outlets for sticky phases
- extended disc area for dispersed liquid/solid mixture (washing)
- blanketing with N<sub>2</sub> against the risk of explosive vapors
- material resistant to dynamic corrosion (strong acid and chloride)

The above design features can be selected and combined once the separation duty and fluid characteristics have been designed.



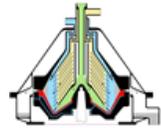
# Macfuge separators: the core technology

mixture properties and process condition

separator design vs separation duty

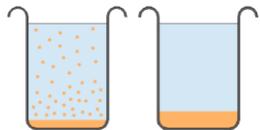


solid bowl separator:  
liquid/liquid separation, no solid

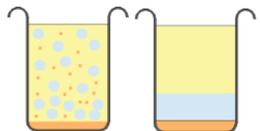


self discharging separator  
solid/liquid/(liquid) separation

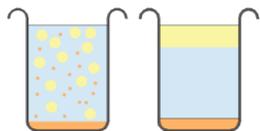
bowl design vs liquid phases in the mixture



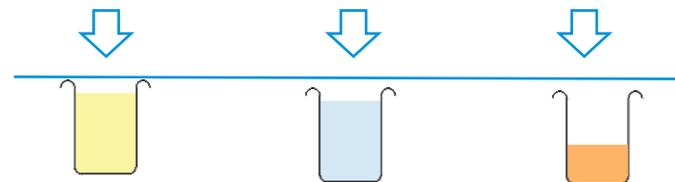
clarifier: one liquid phase only,  
with suspended solid



purifier: two liquid phase,  
the light one being the main



concentrator; two liquid phases,  
the heavy one being the main



area classification risk



none, for safe area



ATEX 3G – hazardous area  
ATEX 2G – explosive product



Nitrogen blanketing system

material selection for erosion and corrosion

duplex  
superduplex  
Moli6, A20 Carpenter  
incoloy, hastelloy cladding

Aisi 304/316/904L  
super stainless steel 904  
replaceable wear part  
EPDM, FKM, Karletz gaskets

control equipment

Frequency Drive  
PLC and HMI  
Macfuge software  
data recording  
data remoting

sensors and monitoring

vibration and speed  
temperature  
pressure  
oxygen (ATEX)

# Macfuge separators: the scope of supply

## THE MACFUGE SERIES ARE AVAILABLE IN THREE MAIN FORMATS

Macfuge **test units**: for lab, research, demo and batch processing

- useful to validate/research new farming method or new species, extracts and post-processing
- available solid retaining models (manual cleaning) for batch processing or self-cleaning models (automatic discharge), which outcome is fully scalable to larger sizes

Macfuge **custom modules**: for continuous processing

- plug and play unit, for easy installation in every environment
- small and medium sizes available, to replicate exactly the industrial plant flowrate and start an average capacity continuous production.

Macfuge **industrial**: larger clarifiers for industrial processing

- larger unit of high efficiency and capacity, derived from the long experience in liquid clarification at industrial level
- customizable with accessories to complete the installation in line, answering the demand of established industrial processing



# Macfuge: materials and execution

## BOWL BODY MATERIAL

- Duplex F51 – SAF 2205: quality choice, high resistance
- Super duplex F55 – SAF2507 for higher corrosion resistance
- other special materials (Inconel, Moli6, Carpenter) for extreme applications
- erosion protection of sliding bottom and ports

## DISCS DESIGN

- high conicity, for higher catching rate and larger settling area
- Bowl design for max clarification efficiency or solid handling
- Disc spacing for max clarification efficiency or high viscosity
- caulks (spacer) fixed by electro or laser welding on demand
- materials: AISI 304, AISI 316, AISI 904

## SURFACE FINISHING (REF MAIN PRODUCT CONTACT SURFACE)

- - 1,6 to 0,8 (ref industrial oil, mineral oil)
- 0,8 (ref food and general hygienic application)
- 0,8 to 0,5 (bio, pharma and chemicals on demand)

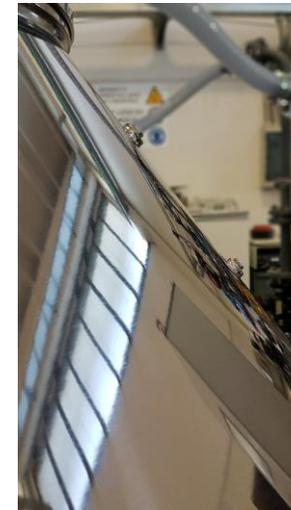


Macfuge module, custom\* execution for nitric acid  
\*bowl body F55, disc 904, other bowl part F51/316



Macfuge prototype\* x DuPont

\*bowl body F55/Moli6, disc 316L, other bowl part Moli6/F51



various execution, parts

# Macfuge: the slurry handling

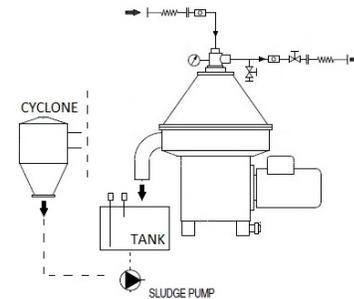
## SOLID HANDLING CAPACITY (VOLUMETRIC):

- manual cleaning: below 0,1% (liquid/liquid) or batch use
- separators automatic discharging: up to 3% v/v
- clarifier automatic discharging: up to 5%
- special high solid volume configuration – up to 10%
- nozzle continuous discharging : up to 20%



## SEPARATED PHASES DISCHARGE:

- via cyclone or directly on sludge tank with sludge pump
- optional special basin design (open volute) for sluggish mass
- flushing point for cleaning and conveying

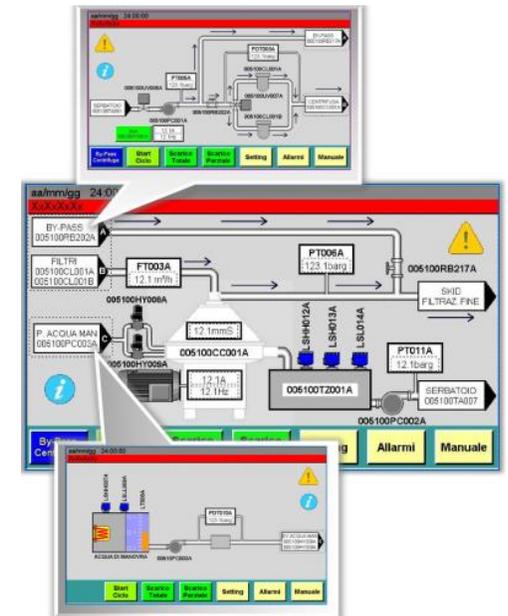
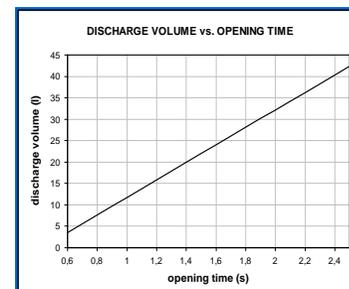


## LIQUID OUTLET FOR “FLUID PASTE” LIKE BIOMASS

- special liquid outlet to convey out fluid biomass

## AUTOMATIC DISCHARGE FUNCTIONS

- partial and total discharge, variable in volume and time
- automation via solenoid valves operated by PLC
- time triggered or external sensor (turbidimeter)



# Macfuge: inlet/outlets and containment

## PRODUCT INLET

- free, open
- under pressure (isobaric) with rotating mechanical seal

## LIQUID(S) OUTLET

- free (regulated by gravity discs)
- under pressure via paring disc (regulated by counter pressure valves)

## BOWL CONTAINMENT

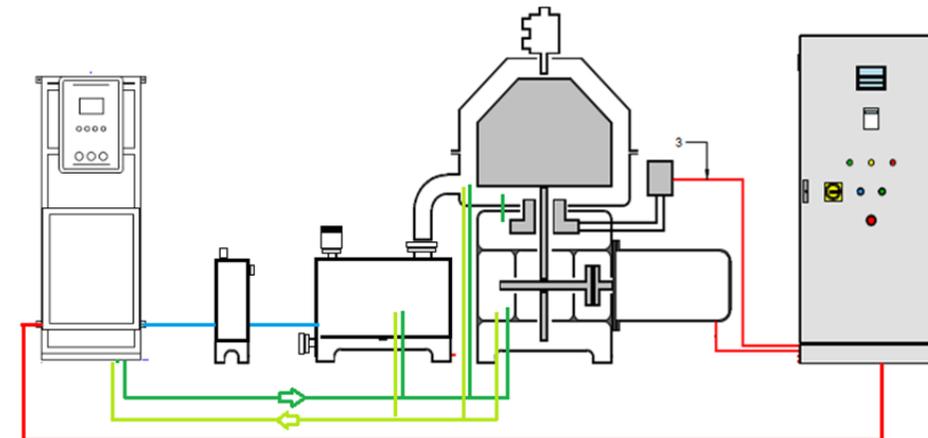
- open
- hydro hermetic – liquid ring barrier (O<sub>2</sub> pick up <50ppm)
- mechanically sealed (rotating seal) (O<sub>2</sub> pick up <5ppm)

## SYSTEM CONTAINMENT

- open
- nitrogen blanketing and/or ex-proof configuration
- Macfuge proprietary N<sub>2</sub> blanketing system (with O<sub>2</sub> sensor)



Macfuge 710 clarifier  
for esterification  
TC removal



- Electrical and communication
- Nitrogen flushing
- Atmosphere control
- Pressure control and hydraulic guard level

# Macfuge: cleanability

## METHODS

- Material and finishing according best practice and standards
- Design execution according guidelines for hygienic design
- Flushing point on bowl, casing, sludge collector
- Ready for selected CIP method
- Interface to CIP module/system
- Validation on FAT/SAT

## CIP

- CIP mode (internal washing sequence)
- programmable CIP sequence (up to 3 stage, extendable)
- interface customizable on existing CIP module or according main commercial one (or on demand)

## On site validation test - FAT

- visual check, by CIP product or water cleaning
- Riboflavin Test for cleaning validation

## DEGREE OF CLEANLINESS

physical

removal of visible dirt from surface

chemical

removal of microscopic residue not visible to naked eye

disinfected/sanitized

de-activation of harmful microorganism. when removed, the equipment is “sanitized”

## VALIDATION TEST:

FAT

options:  
- visual inspection  
- riboflavine test

SAT

onsite production test

# Macfuge: quality assurance

## COMPANY QUALITY STANDARD

- management system ISO 9001:2015
- certificate for materials, surface and welding

## QUALITY DOCUMENTATION PROTOCOLS

- FAT: factory acceptance test
- IQ installation qualification
- SAT site acceptance test
- OQ operational qualification
- PQ performance qualification

## Good Manufacturing Practice: GMP

- customized: to be formalized according project request. For the most is comprehensive of documentation of existing protocols, certificate and management system (traceability)



FAT test with Riboflavine on:  
Macfuge 710 for cysteine production  
Hygienic design, customer standard  
Super duplex execution  
High Centrifugal force  
High cleaning demand (infant food)



# Main customer: end user, engineering, epc



Macfuge as “MAchine centriFUGE”, high efficiency disc separators specially designed for

- customized solutions
- on-time delivery
- outstanding price per value
- worldwide reference and service
- total commitment
- traceability of operation and materials
- made in Italy

Macfuge is a brand of Servizi Industriali, a company founded in 1987, today part of Interpump Group Spa.

Servizi Industriali is located in the heart of Emilia Romagna (ITALY), between Packaging Valley and Motor Valley.

All Macfuge machines are designed and built in the facility in Italy.

Servizi Industriali does not accept any kind of material or service from countries with governments and policies that do not guarantee human rights and the protection of people and of the environment.

Rev: 00  
Data: 13/06/2022

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# Macfuge

Servizi Industriali S.r.l.

Via Marie Curie 19 – 40064

Ozzano dell'Emilia (BO) - Italia  
Tel. +39.051.795080 - Fax +39.051.799337