CENTRIFUGAL SEPARATORS
for industrial use
Sedimentation is one of the most versatile separation processes. **Pieralisi Vertical Separators** (Disc-Stack Separators) are ideally suited to separation processes where the physical characteristics of sedimentation can be applied thanks to density difference.

Centrifugal sedimentation is often a very good and economical alternative to other separation processes such as:

- **Filtration**: based on particle size,
- **Micro-Filtration**: based on particle size in the sub-micron range,
- **Flotation**: based on physical-chemical behaviour, i.e. surface tension.

In many cases centrifugal sedimentation and another complementary technology are combined to achieve the required process results.

### ADVANTAGES

The most common advantages of centrifugal sedimentation, better known as **Centrifugal Separation** are:

- compact size of equipment,
- low capital investment,
- versatility,
- ease of use,
- low operating costs,
- high performance.

### SEDIMENTATION

Sedimentation is the physical process whereby suspensions and emulsions (or a combination of both) are exposed to gravitational force, either the earth’s gravity or by using a centrifuge. By applying g-force, the droplets and/or particles acquire settling velocity ($v_s$) and are sent to the bottom/wall of the container/centrifuge bowl.

Settling velocity ($v_s$) increases with:

- bigger particle diameter,
- higher density difference,
- lower dynamic viscosity of the fluid environment.

Settling velocity can be estimated via a well-known equation known as Stokes’ Law:

$$ v_s = \frac{d^2 (\rho_p - \rho_f) g}{18 \eta} $$

Sedimentation is used in many industrial processes where it is necessary to separate substances that are mixed together (dispersion). With a suitable recipient and the time needed to complete the sedimentation process, the two or more substances with different densities will be separated (stratified) within the recipient, the lightest going to the surface, the heaviest to the bottom. (See illustration below)

### INCREASING CAPACITY

But what can we do if we do not have enough time or if we want to increase capacity? Going back to Stokes’ Law, to obtain an higher settling velocity and consequently to accelerate the sedimentation process, we can replace gravitational acceleration “g” by centrifugal acceleration “$\omega^2 r$”.

The centrifugal acceleration “$\omega^2 r$” produced in a Pieralisi Vertical Separator is up to ten thousand times higher than the ordinary force of gravity “g”. As a consequence, settling velocity is up to ten thousand times faster, and separation can be achieved in a very short time and/or using very small volumes.

$$ v_s = \frac{d^2 (\rho_p - \rho_f) \omega^2 r}{18 \eta} $$

**Modified Stokes’ Law**

N.B. Stokes’ Law can of course only be used when the settling process takes place under conditions when the Reynolds No. is below 0.25. For higher Reynolds No., the Grassmann system has to be used, which takes advantage of two dimension-less parameters: the Archimedes number and the Omega number.
Pieralisi Vertical Separators combine very high rotational speed, a unique design and special materials. They generate a very high centrifugal force which, when used for sedimentation purposes, ensures extremely efficient equipment. The mixture to be separated is forced through a conical disc stack, where multi-layer sedimentation takes place. The separation happens very quickly as the mixture passes through the parallel thin channels of the disc stack. A medium-sized Disc-Stack Separator, when using high centrifugal force, can be compared to the efficiency of a sedimentation tank with a surface area of 60,000 m², the same size as 10 football fields. In technical terms, this separator hosts an “equivalent settling area” of 60,000 m².

**How does it work?**

Thousands of “g”s are produced in the bowl of the Disc Stack Separator, the centrifugal force being the product of the high rotational speed and the large size of the bowl. The rotation is generated by an electric motor connected to the horizontal shaft by means of an elastic coupling or clutch. Thanks to the gear ratio produced by specially-designed gears, the movement is transferred to the vertical shaft. The bowl is assembled on the conical top-end of the vertical shaft. The processing liquid is fed into the centre of the bowl through the stationary feed pipe. Subsequently the inflow is accelerated by means of specially-designed accelerators, forced in the first instance to the periphery of the bowl, and then through the discs where multi-layer separation takes place. The separated liquid(s) flow to the top of the bowl where they are discharged by overflow or by centrifugal pumps. The solids captured via the described settling process are collected at the periphery of the bowl, and then discharged intermittently. This discharge is activated by a hydraulic system located underneath the separation area. In essence, the solids are discharged via openings at the periphery of the bowl which are opened and closed by the down- and upwards movement of either a sliding piston or bowl bottom (see picture).

**Design features**

**Construction materials**

The structural parts of the bowl are made of special stainless steel, the inside parts in contact with the product are made of suitable materials for the processing environment: stainless steel, brass or bronze. The housing of the Vertical Separator is in stainless steel or aluminium and cast iron. The gearbox is made of painted cast iron or cast iron coated with stainless steel. The gasket material is always selected according to the process media.

**Transmission**

The movement is always generated by an electric motor and is transmitted by means of:

- clutch and worm gear;
- flexible coupling worm gear;
- set of pulleys and flat belt.

A special transmission version makes use of a high-speed motor coupled directly to the vertical shaft.

**Feeding and discharge of process liquids**

The mixture generally is fed in through a stationary feed pipe in the centre of the bowl. The separated liquid may be discharged from the Vertical Separator by an overflow or by one or two built-in centrifugal pumps.

**Special versions**

**Sanitary version**

Specially-designed all-stainless-steel Separators, designed to be used with a CIP cycle for cleaning purposes. This version is designed for the easy sanitization of all parts in contact with the product and requires with no manual operation.

**ATEX version**

Specially-designed and certified Vertical Separators, designed to be installed in hazardous areas and for the treatment of potentially inflammable products, i.e. Separators complying with Ii2G Ex cp IIB TB4. These separators are inactivated by means of nitrogen gas to minimise the risk of ignition and to fulfil ATEX requirements.

**Hermetic version**

Hydro-hermetic device installed inside the bowl, designed to ensure that contact with the surrounding environment is avoided, and to prevent oxidation and gas leaks.
Vertical Disc-Stack Separators are normally designed for one type of separation only, but in some cases, more versatile versions are available that can carry out two different types of separation. Below is a list of the range of disc stacks and bowl designs used for different types of separation.

PIERALISI Disc-Stack Separators are able to simultaneously process dispersions of two liquids and one solid. The Pieralisi product range offers three main equipment solutions: one with solids retention (requiring manual cleaning) known as the S-Type, one equipped with nozzles that allow continuous solids discharge, known as the SU Type, and the other with automatic, intermittent solids discharge, known as the FPC-Type. The tables below show types and sizes, with some general indications of dimensions.

### AREAS OF APPLICATION FOR PIERALISI SEPARATION SOLUTIONS

**Environmental Processes**
- treatment and disposal processes of sludge from municipal and industrial waste water
- drying of animal slurry
- drying of biomass
- thermal sludge drying

**Chemical Processes**
- production processes involving intermediate or end products and integrated recycling and recovery processes
- processes within HDPE, PVC and PP polymer production
- production processes for the pharmaceutical and biotech sector
- minerals and ores production processes
- production processes for non-fossil fuels, such as biodiesel and ethanol

**Recycling**
- treatment processes for drilling mud
- treatment and recovery processes for industrial fluids
- recycling of polymers and their respective recyclables
- recycling of service water in industrial processes

**Oleo-chemistry**
- production processes for oleo-chemistry derivates
- refining processes for edible vegetable oils, excluding olive oil

**Mineral- Fuel and Lube Oils Processes**
- purification and conditioning of fuels
- purification of lube oils
- treatment and recovery of mineral and fuel oils
- treatment of slop-oils from refineries and lagoons, of slops from lube oils, of bgle water

**Animal-Based Products**
- treatment of by-products from the fish-processing and meat-processing industries

**Food and Beverage Production**
- processing and recovery of non-liquid food products
- wine and sugar processing
- processing of fruit and vegetable juices
- recycling of food-related products

**Milk & Dairy Products**
- production processes of dairy and cheese products
- recycling of related waste materials
Applications worldwide

Chemical industry

Bioethanol industry

Vegetable oils separation

Fuel oil purification

Slop oils separation

Recycling industry

Biodiesel glycerin separation

Milk treatment

Lube oil treatment
Original Spare Parts
The same attention we pay to design and construction of our machines, is also dedicated to the production of spare parts, so that each machine is able to ensure the maximum reliability and excellent performance over time, without altering the properties of the processed products. All Pieralisi original spare parts are built according to the highest standards of quality and covered by warranty. They can be purchased directly by our service network or through the dedicated web portal: www.ricambioriginalipieralisi.com

Planned Maintenance
A proper maintenance plan makes it possible to prevent and solve the problems related to the normal machine wear, to ensure ongoing high performance and to maintain the value of the investment unchanged over time. Pieralisi has two solutions for planned maintenance:
LIGHT is the standard option ideal for 2 to 4 inspections at a fixed price;
HEAVY is the special option that proposes the replacement of the worn parts in addition to the 4 inspections.

Pieralisi Planned Maintenance is:
- CHEAPER, because it always offers a discount on the original spare parts used for all maintenance operations and labor costs are reduced and protected from any rise;
- MORE EFFICIENT, because the prior checks and the related operations allow you to optimize performance in terms of extraction yields and energy consumption;
- SAFER, because our maintenance operations are conducted in compliance with the local laws on safety. Moreover our specialized technicians always provides all necessary information for the proper running of the machines;
- MORE FLEXIBLE, because our worldwide service network is highly specialized and ensures a qualified maintenance wherever the machines are located.

Extra Maintenance
In order to maintain over time machines value, reliability and performance, we offer three types of action, GOLD, SILVER and BRONZE, depending on the machine conditions. All operations are performed in Pieralisi production plant and covered by warranty.