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## CLARIFLOCCULATORS

### Outlines of the Clariflocculation Process

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We wrote about the theory of sedimentation in the section of the “Scraper Bridges for Sedimentation Tanks”.

In the Sedimentation with flocculation the particles do not keep their individuality, but tend to agglomerate helped by some coagulants. The sludge floc size increases and, as a consequence, the sedimentation speed increases too.

### SEDIMENTATION WITH FLOCCULATION

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A complete process of clarification mainly consists of three subsequent stages:

- Mixing of the inflow (waste water) with the reagents
- Flocculation
- Sedimentation

The waste water mixing with the reagents must be made very quickly and with a strong stirring. On the contrary, the flocculation must be slow in order to allow the flocs agglomeration and any turbulent motion must be avoided.

The clarified water is then collected in the upper part through circular or radial ditches, the sludge sediments on the tank bottom and is conveyed into a drain well by some scrapers.

### CLARIFLOCCULATOR WITH SLUDGE RECYCLE

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The clariflocculator with sludge recycle is equipped with a turbine to recycle and mix the already settled sludge with the new water to be treated which has already been conditioned with reagents. The “old” sludge flocs, usually of medium-large size, help the production of new sludge flocs.

The conditioned water, when entering the clariflocculator, is mixed with the settled sludge in the reaction chamber as it is lifted by a radial-axial flow turbine.

It is fundamental that this operation occurs at the minimum speed as possible for not breaking the sludge flocs.

The sludge recycle flow rate is variable and is adjusted by means of a variable-speed geared motor. The lifted sludge and the water to be treated, after having been mixed in the reaction zone, are conveyed to the flocculation zone where the flocs gather and become larger and the settling phase begins.

The clarified water can be collected through radial or peripheral ditches.

The radial ditches are more efficient because the water flow towards them is more homogeneous and the flow speed does not become too fast in certain zones.

According to the already mentioned Stokes' law, the settling speed is higher for larger suspended solids.

**Conclusions** For the same flow rate of water to be treated, the clariflocculators require smaller tanks.

Our range of production includes the following types of Clariflocculators:

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- Accelerator type clariflocculator with turbine for sludge recycle mod. EM11
- Central drive clariflocculator with turbine for sludge recycle mod. EM20
- Peripheral drive clariflocculator with gate mixers mod. EM21A
- Peripheral drive clariflocculator with turbine for sludge recycle mod. EM21B
- Clariflocculator with torsion trestle and turbine for sludge recycle mod. EM22

# TECHNICAL COMPARISON BETWEEN CLARIFLOCCULATORS AND ACCELATORS

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This is a qualitative comparative study of the realization, process requirements and degree of simplicity of construction and running between *CLARIFLOCCULATORS* and *ACCELATORS*.

This comparative study was carried out on the basis of the general configuration of the two machines (placed in the same tank to make the comparison).

The Clariflocculator and Accelator must accomplish:

1. a process of contact between the pre-existing sludge and the incoming waste water to obtain larger flocs which tend to sediment more easily;
2. a process of sedimentation based on Stokes' law.

The clarified water re-surfacing speed remains, according to the experimental results achieved in machines with a process of sludge contact, between 2 and 2.5 m/h. with light sludge (such as  $Al(OH)_3$ ).

Here is a description of how the processes 1 and 2 are accomplished.

## **Clariflocculator**

1A: There is a small, but well stirred, contact zone between the sludge and the incoming waste water where the intimate contact is ensured.

After the intimate mixing, the period of contact is kept in a "calm" volume, there is no narrowing so the flocs integrity is respected and they can gather and become larger in the next calm zone.

2A: The "calm" volume allows to convey the water to be treated to the sedimentation zone, at a very low elevation, without any turbulence and with a gradual slowing down due to the section widening along the waste water flowing upwards.

## **Accelator**

1B: There is no zone of intimate mixing, the volume (and the time of contact) is almost the same as in the clariflocculator and coincides with the mixing time. There is a narrow passage between the mixing zone outlet and the gate to regulate the outflow opening, therefore the newly formed floc risks to break just before entering the sedimentation zone.

2B: The flowing from the contact volume to the sedimentation zone is faster than in the clariflocculator, so more whirling, moreover it occurs at a very high elevation, near the zone where water is already clear. Therefore there is a high risk of sludge overflow into the clarified water.

As for the simplicity of 3) construction and 4) running, we point out that:

3A: The clariflocculator turbine is smaller, so the manufacturing of the rotary part is simpler in terms of centering and vibrations; the only adjustment of the rotation speed allows to eliminate complicated mechanisms.

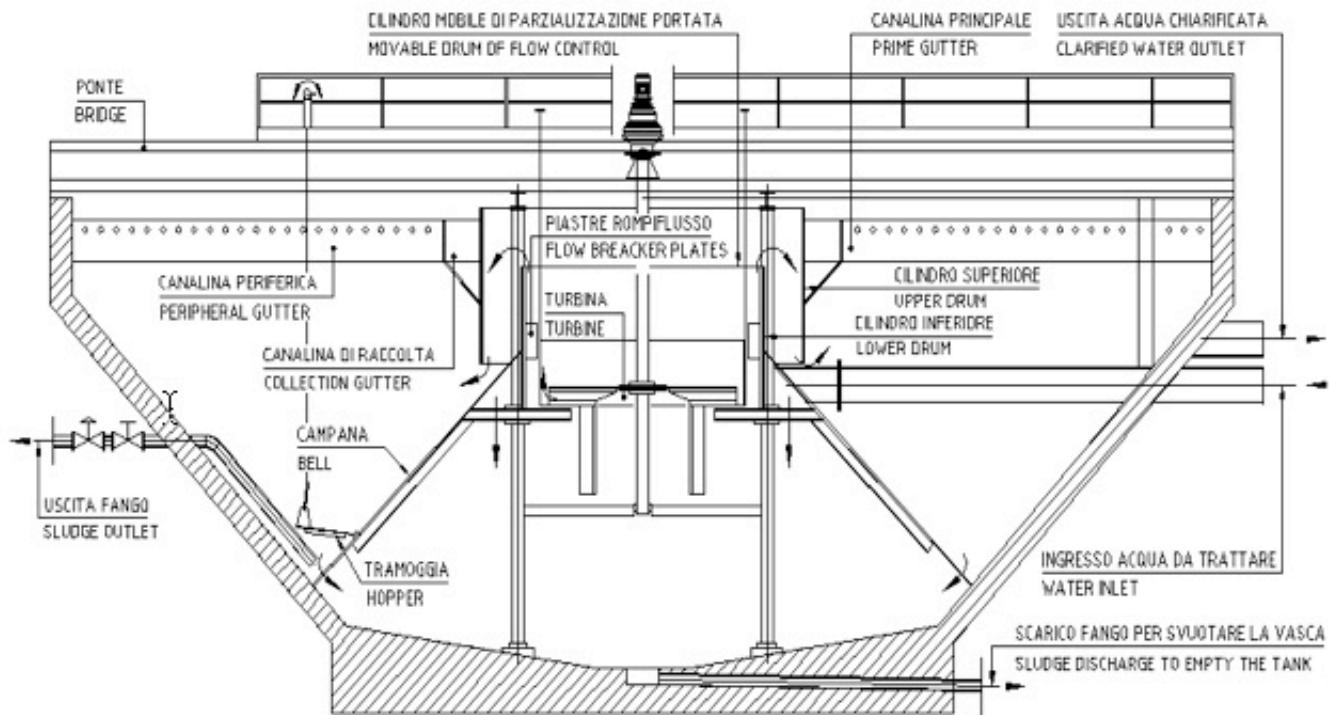
4A: The automatic extraction of sludge, interlocked with a turbidimeter, allows to avoid any manual control and eliminates the risk of producing a not completely clear water, due to a lack of sludge discharge, in case of a suddenly turbid feed of waste water.

## **Accelator**

3B: The manufacturing and centering of the big turbine are particularly difficult; the mechanism (manual) to regulate the turbine outflow opening often gets blocked.

4B: The extraction of sludge is manual so in case of a suddenly turbid feed of waste water there is a risk of discharging turbid water.

# ACCELATOR WITH TURBINE FOR SLUDGE RECYCLE MOD. EM 11



<b>Application</b>	Clarifying of primary waste water
<b>Characteristics</b>	The equipment consists of a flocculation zone, inside the cone, a sedimentation-clarification zone, outside the cone, hoppers to collect the settled material, ditches to collect the clarified water.
<b>Operation</b>	The sedimented sludge flocs are kept in suspension by a turbine, recycled and mixed with the water to be treated. The solids in the incoming water settle over the existing recycled sludge flocs. The new flocs volume increases and they tend to sediment more easily.
<b>Materials</b>	Hot dip galvanized carbon steel or Stainless steel.
<b>Installation</b>	In a concrete tank.
<b>Tank diameter</b>	From 8 to 50 m.

## Outlines of the Process

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The flocculation must occur in a moderate and not turbulent way. This will help the sludge flocs creation and ageing and, at the same time, prevent their settling on the tank bottom.

## Operation description

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In the Accelerator the suspension is recycled from the sludge-bed chamber to the reaction chamber. The reagents are added directly into the suspension of the precipitated sludge so that the reaction makes the suspended particles size grow rather than produce a precipitation of new particles. Then the suspension goes to a secondary reaction zone and subsequently to the concentration zone, from where it can return to the primary reaction chamber.

In the Accelerator:

- the primary reaction chamber is inside the cone
- the secondary reaction chamber is downstream the turbine

The rotary stirrer blades angle produces the circulation.

The sludge drainage is achieved by closing the sluice gates which do not allow the sludge to return to the reaction zone from the concentration zone. The sludge sediments on the bottom of the hopper; the concentrated sludge is drained by gravity by opening the drain valves.

The clarified water is collected in the upper part through radial ditches.

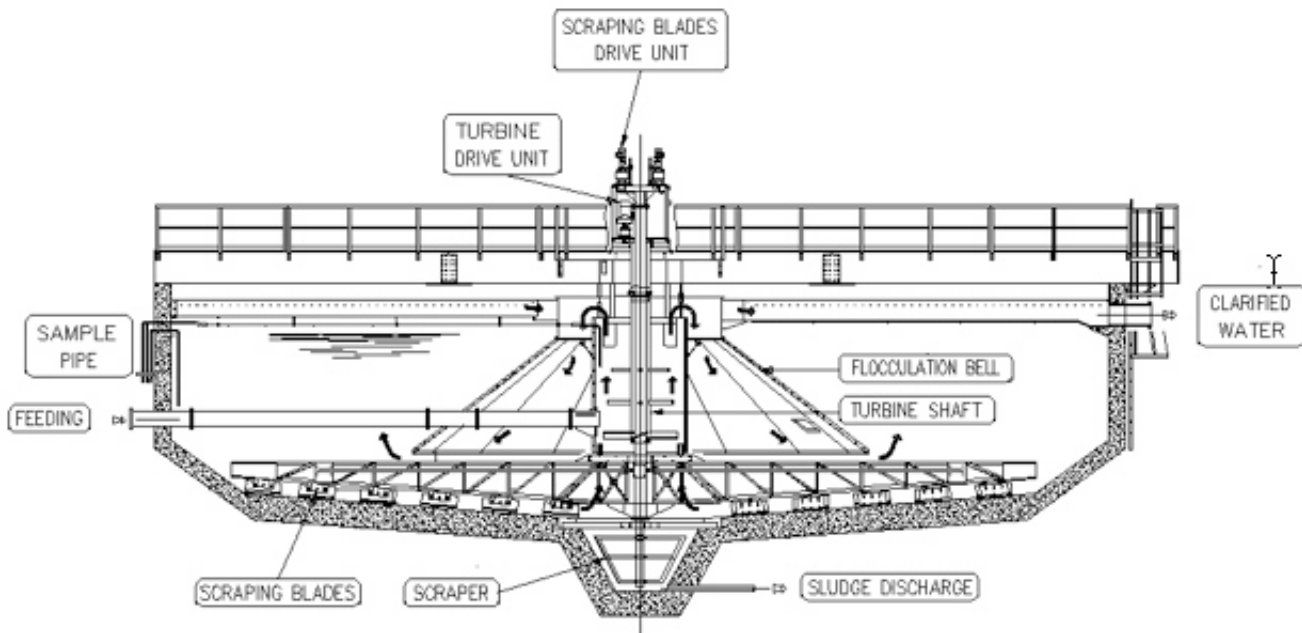
The Accelerator is not equipped with bottom scrapers. In some cases only, for equipments of more than 25 m., it could be necessary to install some bottom scrapers to convey the sludge into the hopper.

## Technical data

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1.1	Design flow rate	: m <sup>3</sup> /h
1.2	Min-max sludge recycle flow rate	: m <sup>3</sup> /h
1.3	Flocculation turbine min-max speed	: r.p.m.
1.4	Flocculation chamber useful volume	: m <sup>3</sup>
1.5	Flocculation contact time	: min.

# CENTRAL DRIVE CLARIFLOCCULATOR WITH TURBINE FOR SLUDGE RECYCLE MOD. EM 20



<b>Application</b>	Clarifying of primary waste water.
<b>Characteristics</b>	The equipment consists of a flocculation zone, inside the cone, a clarification zone, outside the cone, a sedimentation zone at the tank bottom, bottom scrapers to convey the settled sludge to the central drain well, radial ditches to collect the clarified water.
<b>Operation</b>	The sedimented sludge flocs are kept in suspension by a turbine, recycled and mixed with the water to be treated. The solids in the incoming water settle over the existing recycled sludge flocs. The new flocs volume increases and they tend to sediment more easily.
<b>Materials</b>	Hot dip galvanized carbon steel or Stainless steel.
<b>Installation</b>	In a concrete tank.
<b>Tank diameter</b>	From 8 to 30 m.
<b>Advantages</b>	High efficiency of sedimentation.
<b>Optional</b>	Radial structural steel ditches

## Outlines of the Process

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The flocculation must occur in a moderate and not turbulent way. This will help the sludge flocs creation and ageing.

### Operation description

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In the Clariflocculator the suspension is recycled from the tank bottom to the reaction chamber. The flocculation, which takes place in the clariflocculator, makes the suspended particles size grow rather than produce a precipitation of new particles.

Then suspension goes to a secondary reaction zone and subsequently to the concentration zone, from where it can return to the primary reaction chamber.

In the Clariflocculator:

- the primary reaction chamber is inside the cylinder which contains the axial turbine
- the secondary reaction chamber is outside the cylinder but inside the cone

The function of the turbine is:

- lifting the sludge settled on the tank bottom
- mixing the newly formed sludge flocs with the suspension in the water to be treated

The reagents are added and mixed with the water to be treated, just before the waste water enter the reaction chamber.

The sludge is conveyed to the central hopper by some scrapers.

The sludge sediments on the bottom of the hopper; the concentrated sludge is drained by gravity by opening the drain valves.

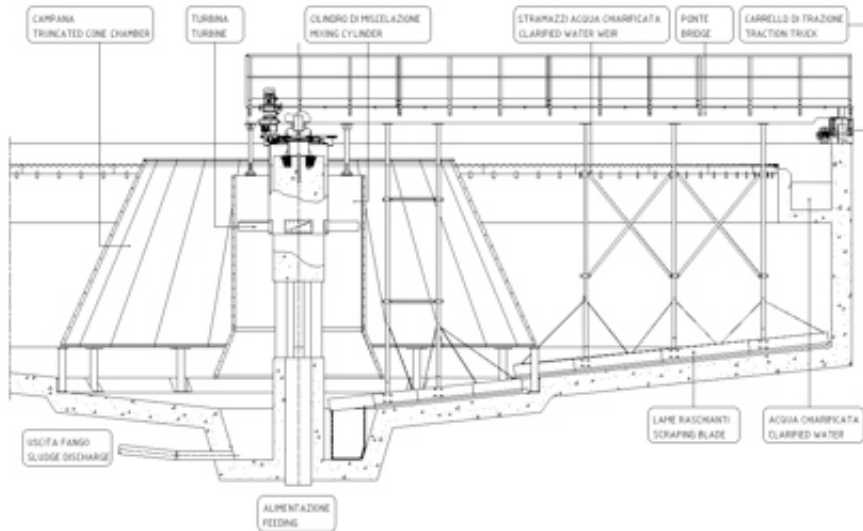
The clarified water is collected in the upper part through radial ditches.

### Technical data

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1.1	Design flow rate	: m <sup>3</sup> /h
1.2	Min-max sludge recycle flow rate	: m <sup>3</sup> /h
1.3	flocculation turbine min-max speed	: r.p.m.
1.4	Flocculation chamber useful volume	: m <sup>3</sup>
1.5	Flocculation contact time	: min.

# PERIPHERAL DRIVE CLARIFLOCCULATOR WITH TURBINE FOR SLUDGE RECYCLE MOD. EM 21B



<b>Application</b>	Clarifying of primary waste water.
<b>Characteristics</b>	The equipment consists of a flocculation zone, inside the cone, a clarification zone, outside the cone, a sedimentation zone at the tank bottom, bottom scrapers to convey the settled sludge to the central drain well, radial ditches to collect the clarified water.
<b>Operation</b>	The sedimented sludge flocs are kept in suspension by a turbine, recycled and mixed with the water to be treated. The solids in the incoming water settle over the existing recycled sludge flocs. The new flocs volume increases and they tend to sediment more easily.
<b>Materials</b>	Hot dip galvanized carbon steel or Stainless steel.
<b>Installation</b>	In a concrete tank.
<b>Tank diameter</b>	From 8 to 60 m.
<b>Advantages</b>	High efficiency of sedimentation.
<b>Optional</b>	Scum removal system.

## Outlines of the Process

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The flocculation must occur in a moderate and not turbulent way. This will help the sludge flocs creation and ageing.

### Operation description

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In the Clariflocculator the suspension is recycled from the tank bottom to the reaction chamber. The flocculation, which takes place in the clariflocculator, makes the suspended particles size grow rather than produce a precipitation of new particles.

Then suspension goes to a secondary reaction zone and subsequently to the concentration zone, from where it can return to the primary reaction chamber.

In the Clariflocculator:

- the primary reaction chamber is inside the cylinder which contains the axial turbine
- the secondary reaction chamber is outside the cylinder but inside the cone

The function of the turbine is:

- lifting the sludge settled on the tank bottom
- mixing the newly formed sludge flocs with the suspension in the water to be treated

The reagents are added and mixed with the water to be treated, just before the waste water enter the reaction chamber.

The sludge is conveyed to the central hopper by some scrapers.

The sludge sediments on the bottom of the hopper; the concentrated sludge is drained by gravity by opening the drain valves.

The clarified water is collected in the upper part through peripheral ditches.

### Technical data

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1.1	Design flow rate	: m <sup>3</sup> /h	(*)
1.2	Min-max sludge recycle flow rate	: m <sup>3</sup> /h	
1.3	flocculation turbine min-max speed	: r.p.m.	
1.4	Flocculation chamber useful volume	: m <sup>3</sup>	
1.5	Flocculation contact time	: min.	

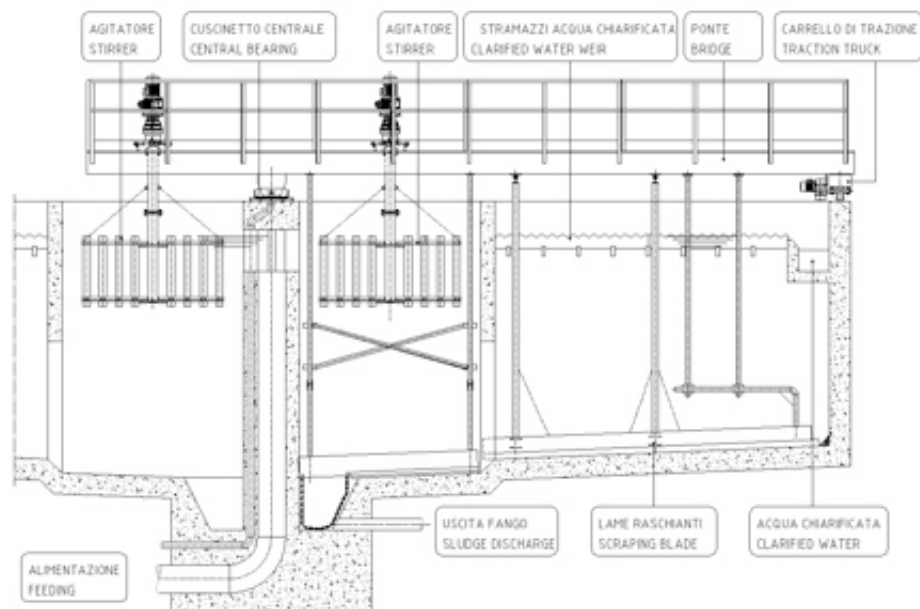
### Peculiarities

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The Clariflocculator mod. EM21B has a rotary bridge with radial scrapers. The turbine unit is supported by a central column and the turbine turns outside this central column.

As this model of Clariflocculator has a rotary bridge, it cannot be equipped with radial ditches.

# PERIPHERAL DRIVE CLARIFLOCCULATOR WITH GATE MIXERS MOD. EM 21A



<b>Application</b>	Clarifying of primary waste water.
<b>Characteristics</b>	The equipment consists of a flocculation zone, inside the cone, a clarification zone, outside the cone, a sedimentation zone at the tank bottom, bottom scrapers to convey the settled sludge to the central drain well, radial ditches to collect the clarified water.
<b>Operation</b>	The sedimented sludge flocs are mixed with the water to be treated by the gate mixers. The solids in the incoming water are mixed with the settled sludge flocs. The new flocs volume increases and they tend to sediment more easily.
<b>Materials</b>	Hot dip galvanized carbon steel or Stainless steel.
<b>Installation</b>	In a concrete tank.
<b>Tank diameter</b>	From 8 to 60 m.
<b>Advantages</b>	High efficiency of sedimentation.
<b>Optional</b>	Scum removal system.

## Outlines of the Process

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The flocculation must occur in a moderate and not turbulent way.  
This will help the sludge flocs creation and ageing.

### Operation description

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In the Clariflocculator with gate mixers the suspension is flocculated inside the flocculation cylinder by means of slow gate mixers, minimum no. 2 (at 180° from each other) and maximum no. 4 (at 90° from each other).

The reagents are added directly into the water to be treated, before it enters the clariflocculator. The flocculation, which takes place inside the cylinder, makes the suspended particles gather and grow.

The sludge in suspension, which comes out of the flocculation cylinder, tends to sediment.

The clarified water is collected in the upper part through a circular ditch.

The sludge sedimented on the bottom is conveyed to the central drain well by some scrapers.

In the Clariflocculator:

- the flocculation chamber is inside the cylinder which contains the gate mixers
- the sludge settles under the flocculation cylinder

The function of the gate mixers is:

- mixing the sludge flocs and making them become larger

### Technical data

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1.1	Design flow rate	: m <sup>3</sup> /h	(*)
1.2	Flocculation cylinder useful volume	: m <sup>3</sup> /h	
1.3	Flocculation contact time	: min.	
1.4	Number of gate mixers	: n°	from 2 to 4
1.5	Gate mixers gradient of velocity	: sec <sup>-1</sup> .	from 20 to 40

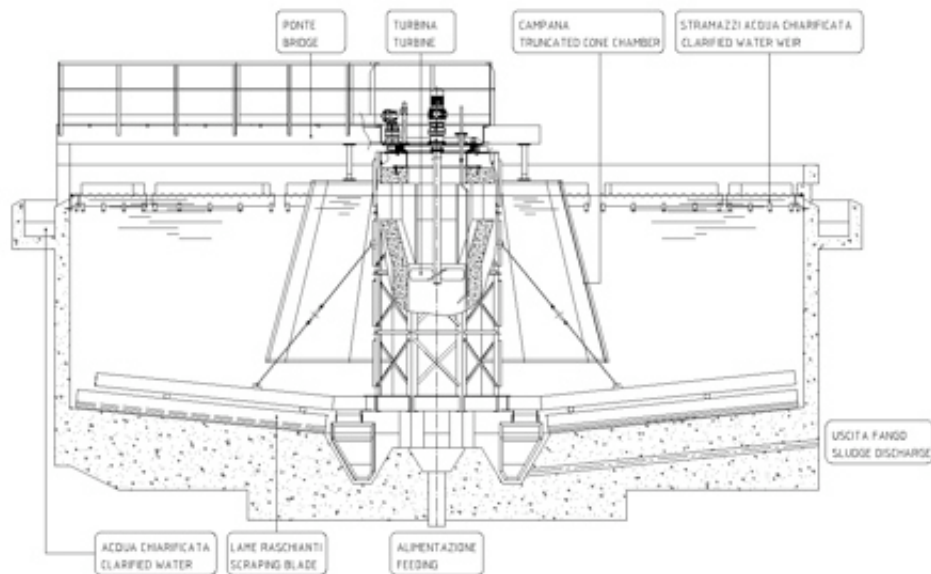
### Peculiarities

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Il chiariflocculatore mod. EM21B ha un ponte rotante con delle raschie radiali. Le turbine di flocculazione sono sostenute dal ponte rotante.

Il chiariflocculatore, avendo un ponte rotante, non può essere dotato di canalette radiali.

# CLARIFLOCCULATOR WITH TORSION TRESTLE AND TURBINE FOR SLUDGE RECYCLE MOD. EM 22



<b>Application</b>	Clarifying of primary waste water.
<b>Characteristics</b>	The equipment consists of a mixing one, inside the central cylinder, a flocculation zone, inside the cone, and a torsion trestle which moves the scrapers to convey the settled sludge to the central drain well.
<b>Operation</b>	The sedimented sludge flocs are kept in suspension by a turbine, recycled and mixed with the water to be treated. The solids in the incoming water settle over the existing recycled sludge flocs. The new flocs volume increases and they tend to sediment more easily.
<b>Materials</b>	Hot dip galvanized carbon steel or Stainless steel.
<b>Installation</b>	In a concrete tank.
<b>Tank diameter</b>	From 8 to 60 m.
<b>Advantages</b>	High efficiency of sedimentation.
<b>Optional</b>	Structural steel radial ditches.

## Outlines of the Process

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The flocculation must occur in a moderate and not turbulent way.  
This will help the sludge flocs creation and ageing.

### Operation description

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In the Clariflocculator with torsion trestle and turbine, the suspension is flocculated inside the flocculation cylinder by means of a variable-speed turbine.  
The reagents are added directly into the water to be treated, before it enters the clariflocculator.  
The flocculation, which takes place outside the cylinder but inside the cone (bell), makes the suspended particles gather and grow.  
The sludge in suspension, which comes out of the flocculation cone, tends to sediment.  
The clarified water is collected in the upper part through radial or circular ditches.  
The sludge sedimented on the bottom is conveyed to the central drain well by some scrapers.

In the Clariflocculator:

- the flocculation chamber is inside the cone (bell) but outside the cylinder which contains the turbine
- the sludge settles under the flocculation cone

The function of the turbine is:

- mixing the sludge flocs slowly and making them become larger

### Technical data

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1.1	Design flow rate	: m <sup>3</sup> /h	(*)
1.2	Flocculation cylinder useful volume	: m <sup>3</sup> /h	
1.3	Flocculation contact time	: min.	
1.4	flocculation turbine min-max speed	:r.p.m.	

### Peculiarities

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The Clariflocculator mod. EM22 has a rotary torsion trestle with two scraper arms.  
The flocculation turbine is in the central cylinder.