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SCRAPER BRIDGES FOR SLUDGE THICKENERS

Thickening is the process by which the water in excess is eliminated, the volumes are reduced and the solid phase of sludge becomes homogeneous.

The sludge extracted from the hoppers of the primary and secondary sedimentation tanks is thickened by gravity in a circular basin equipped with a scraping system and thickening pickets. While rotating inside the tank, the pickets connected to the arms disgregate the sludge flocs, supporting the elimination of water and gas from sludge, and so its sedimentation.

Given the long period of permanence, it is possible that the sludge produces some surface crusts. To break the surface crusts some “counter pickets” are installed on the bridge over the tank.

The liquid phase of sludge is evacuated by means of surface weirs and is conveyed to the head of the plant with the drained water, while the bottom scrapers convey the thickened sludge into the central drain well.

Our range of production includes the following types of Scrapers for Thickeners:

Central drive thickener scraper bridge mod. EM10A
Peripheral double drive thickener scraper bridge mod. EM10C
Thickener scraper bridge with torsion trestle mod. EM10D

Outlines of Sludge Thickening

A suspension of solids laying in a tank, and having a concentration exceeding 500 ppm, tends to sediment and stratify. We can distinguish 4 different areas of concentration:
The first area is composed by clarified water.
The second area is characterized by the presence of particles which sediment freely, without any obstacles.
The third zone is the one in which the solids concentration is equal to that of the original suspension. In this area the sludge particles interfere each other. Under these conditions the movement of a particle is linked to the one of the contiguous particles, so we have a mass motion which leads to the formation of sludge big flocs.
In the fourth zone the solids concentration is particularly high and the particles are all in contact. Under these conditions the thickening process is caused by the compression of the particles coming from the top, due to their own weight.

The aim of this process is the sludge thickening. Its concentration is normally increased from 0,5-1 % to 5-6%.

A traditional thickener is sized on the basis of the solids flow rate FS, expressed in kgSS /(m^2 x g).
The average value of FS is 80 kgSS /(m^2 x g)
For instance, if we have to thicken 1000 m^3/g of sludge at 1% , i.e. 10,000 kgSS/g

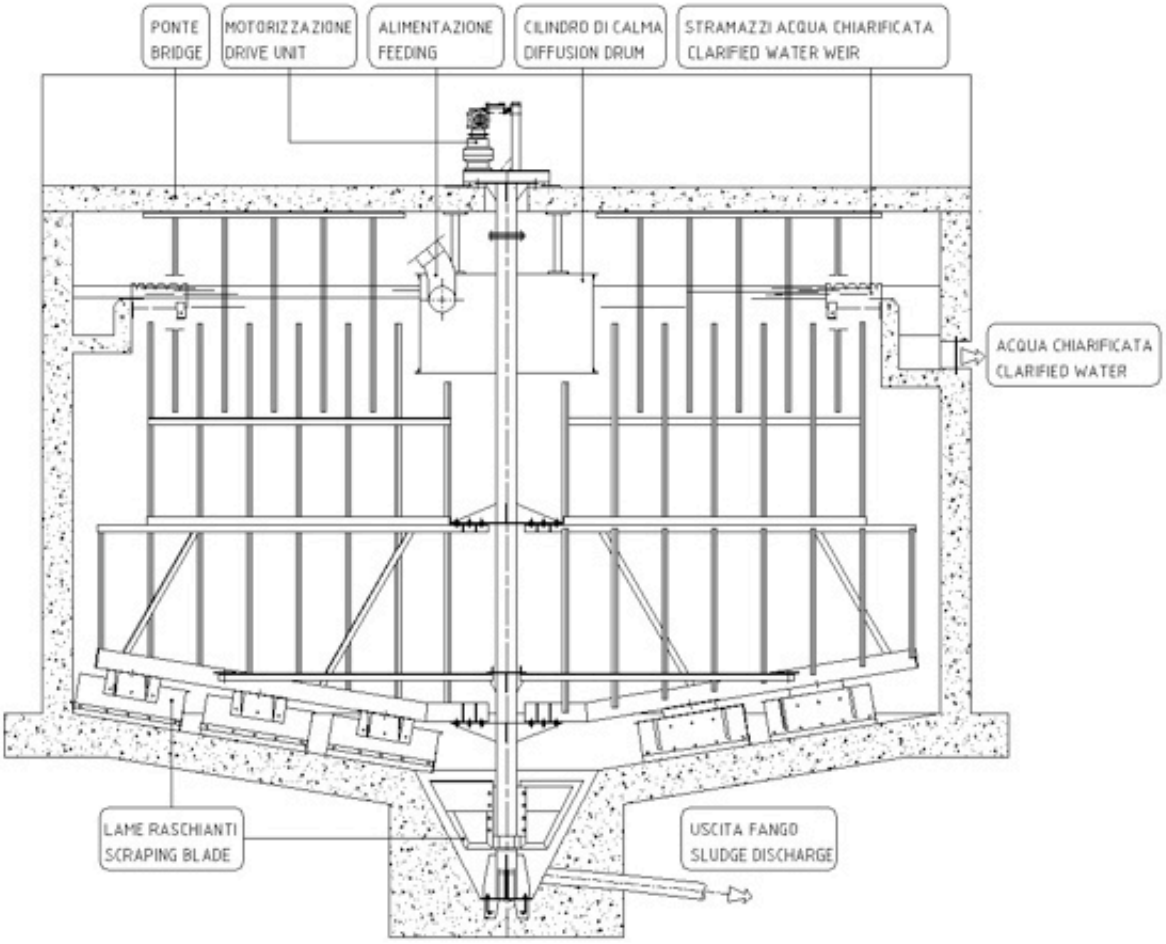
and we apply the FS average value of 80 kgSS /(m^2 x g), we obtain: 10000/80 = 125 m^2
From which we obtain a tank radius of 12. 6 m.

Volume calculation:
We hypothize a useful height of 3 m. and we obtain the total volume of the basin: 125 x 3 = 375 m^3
Then we check the permanence of the sludge in the basin:

Time = volume / flow rate= (375/1000) x 24 = 9 hours

The importance of time is mainly due to the risk of a biological anaerobical activity with the consequent emission of bad smells. In order to control this risk it is useful the sludge should remain in the basin for less than 24÷30 hours.

CENTRAL DRIVE THICKENER FOR CIRCULAR TANK
Mod. EM10A



Application	Sludge thickening
Characteristics	The equipment consists of a drive unit, a slow central shaft, two scraper arms, thickening pickets and a diffusion drum.
Operation	The sludge to be thickened flows into the central drum where the kinetic energy is slowed down, the sedimentable solids settle on the tank bottom and are conveyed towards to central drain well by the bottom scrapers.
Materials	Hot dip galvanized carbon steel or Stainless steel.
Installation	In a concrete tank.
Tank diametre	From 2 to 30 m.
Optionals	Scum removal system

Principles of sizing

L'The sizing of the Thickener is based on the amount of sludge to be scraped on the tank bottom.
Usually the central shaft and the scrapers are sized to bear a stress of 50 kg. per linear metre.
The torque to be transmitted is calculated with the following formula:

$T\ [kgm] = r^2 \times K$

where r is the tank radius and K is the load on the scrapers per linear metre (K = for biological thickeners).
To be reliable, the drive unit shall be capable of transmitting a 1.8 higher torque than the design value.

Torque limiting device (dynamometric cell)
The dynamometric cell measures the torque transmitted by the drive unit.
This value is evident directly on the instrument and allows to evaluate the stresses on the central shaft during its rotation.
The cell is equipped with limit switches set at two different torque values, one for alarm and one for the machine shutdown.

Selection of the electric motor
The electric motor size is selected so that, in case of shutdown, its static torque is lower than the one which can be borne by each downstream unit.
For this reason the electric motor is usually very small.
Exuberant motors may cause, in case of shutdown, serious damages to the structures if the dynamometric cell device fails to intervene or if it is not properly connected.

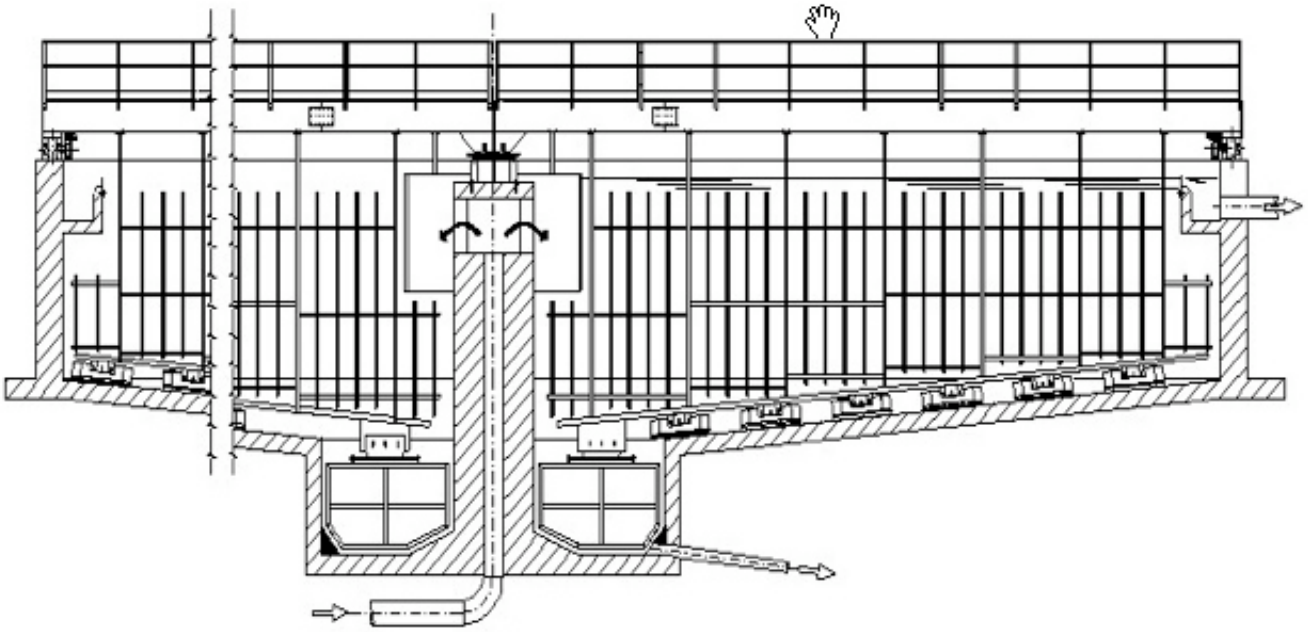
Example of calculation:

Tank diametre 10 m.
K = 20
Scrapers peripheral speed 1.5 m/min
Slow shaft speed 0.047 RPM
Torque $r^2 \times K = 25 \times 50 = 1250$ kgm

so the drive unit shall be designed to transmit a 1.8 higher torque.

Electric motor:
To transmit a torque of 1250 kgm at 0.047 rpm, 61.37 watt are necessary.
If we hypothize a drive unit output of 60%, the electric motor shall have a power of 102 watt.
Normally it is difficult to find electric motors which are smaller than 0.18 kw - 180 watt.
If the selected motor has got a power of 180 watt, in case of shutdown it might give a 2.6 times higher power for a few seconds, i.e. 468 watt. The torque transmitted by the motor to the slow shaft, with a drive unit output of 60%, would be equal to 5700 kgm.
The thickening structure should be sized taking into consideraton this torque value.

PERIPHERAL DOUBLE DRIVE THICKENER FOR CIRCULAR TANK Mod. EM10C



Application	Sludge thickening
Characteristics	The equipment consists of a drive unit, a slow central shaft, two scraper arms, thickening pickets and a diffusion drum.
Operation	The sludge to be thickened flows into the central drum where the kinetic energy is slowed down, the sedimentable solids settle on the tank bottom and are conveyed towards to central drain well by the bottom scrapers.
Materials	Hot dip galvanized carbon steel or Stainless steel.
Installation	In a concrete tank
Tank diametre	From 2 to 30 m.
Optionals	Scum removal system

Principles of sizing

The sizing of the Thickener is based on the amount of sludge to be scraped on the tank bottom. Usually the central shaft and the scrapers are sized to bear a stress of 50 kg. per linear metre. The torque to be transmitted is calculated with the following formula:

$T\ [kgm] = r^2 \times K$

where r is the tank radius and K is the load on the scrapers per linear metre (K = for biological thickeners).
To be reliable, the drive unit shall be capable of transmitting a 1.8 higher torque than the design value.

Torque limiting device (dynamometric cell)
The dynamometric cell measures the torque transmitted by the drive unit.
This value is evident directly on the instrument and allows to evaluate the stresses on the central shaft during its rotation.
The cell is equipped with limit switches set at two different torque values, one for alarm and one for the machine shutdown.

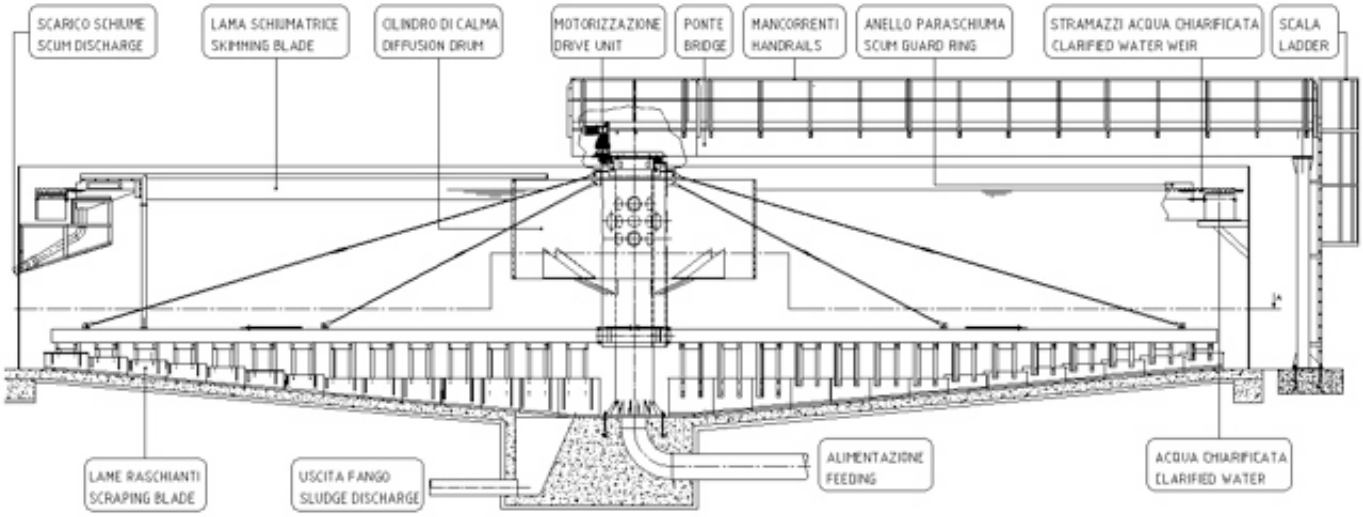
Selection of the electric motor
The electric motor size is selected so that, in case of shutdown, its static torque is lower than the one which can be borne by each downstream unit.
For this reason the electric motor is usually very small.
Exuberant motors may cause, in case of shutdown, serious damages to the structures if the dynamometric cell device fails to intervene or if it is not properly connected.

Example of calculation:
Tank diametre 10 m.
K = 50
Scrapers peripheral speed 1,5 m/min
Torque $r^2 \times K = 25 \times 50 = 1250$ kgm

so the drive unit shall be designed to transmit a 1.8 higher torque.

Electric motor:
To transmit a torque of 1250 kgm the thrust of each trolley must be 1250 : 5 : 2 = 125 kg.
If the wheel diameter is 300 mm, the torque on the shaft is 125 X 0.15 (wheel radius) = 18.75 kgm.
Therefore, at a speed of about 1.2 rpm, 23 watt are necessary. If we hypothize a drive unit output of 60%, the electric motor shall have a power of 38 watt.
Normally it is difficult to find electric motors which are smaller than 0.18 kw - 180 watt.
If the selected motor has got a power of 180 watt, in case of shutdown it might give a 2.6 times higher power for a few seconds, i.e. 468 watt.
The torque transmitted by the motor to the wheel slow shaft with a drive unit (on the trolleys) output of 60% would be equal to 48 kgm, the trust of the trolley would be 320 kg and the torque 1600 kgm for each trolley (total 3200 kgm).
The central column must be designed to bear a torsion stress (in case of shutdown) of 3200 kgm.

THICKENER WITH TORSION TRESTLE FOR CIRCULAR TANK
Mod. EM10D



Application	Sludge thickening
Characteristics	The equipment consists of a drive unit, a slow central shaft, two scraper arms, thickening pickets and a diffusion drum.
Operation	The sludge to be thickened flows into the central drum where the kinetic energy is slowed down, the sedimentable solids settle on the tank bottom and are conveyed towards to central drain well by the bottom scrapers.
Materials	Hot dip galvanized carbon steel or Stainless steel.
Installation	In a concrete tank
Tank diametre	From 2 to 30 m.
Optionals	Scum removal system

Principles of sizing

The sizing of the Thickener is based on the amount of sludge to be scraped on the tank bottom. Usually the central shaft and the scrapers are sized to bear a stress of 50 kg. per linear metre. The torque to be transmitted is calculated with the following formula:

$T\ [kgm] = r^2 \times K$

where r is the tank radius and K is the load on the scrapers per linear metre (K = for biological thickeners).

To be reliable, the drive unit shall be capable of transmitting a 1.8 higher torque than the design value.

Torque limiting device (dynamometric cell)
The dynamometric cell measures the torque transmitted by the drive unit.
This value is evident directly on the instrument and allows to evaluate the stresses on the central shaft during its rotation.
The cell is equipped with limit switches set at two different torque values, one for alarm and one for the machine shutdown.

Selection of the electric motor
The electric motor size is selected so that, in case of shutdown, its static torque is lower than the one which can be borne by each downstream unit.
For this reason the electric motor is usually very small.
Exuberant motors may cause, in case of shutdown, serious damages to the structures if the dynamometric cell device fails to intervene or if it is not properly connected.

Example of calculation:
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so the drive unit shall be designed to transmit a 1.8 higher torque.

Electric motor:
To transmit a torque of 1250 kgm at 0.047 rpm, 61.37 watt are necessary. If we hypothize a drive unit output of 60%, the electric motor shall have a power of 102 watt. Normally it is difficult to find electric motors which are smaller than 0.18 kw - 180 watt. If the selected motor has got a power of 180 watt, in case of shutdown it might give a 2.6 times higher power for a few seconds, i.e. 468 watt. The torque transmitted by the motor to the slow shaft, with a drive unit output of 60%, would be equal to 5700 kgm. The thickening structure should be sized taking into consideraton this torque value.