

FS-PRE-001

**TECHNOLOGY FACT SHEETS
FOR EFFLUENT TREATMENT PLANTS
IN TEXTILE INDUSTRY**

SCREENING / SIEVING

SERIES: PRETREATMENTS

TÍTULO	SCREENING / SIEVING (FS-PRE-001)
Last update	December 2014
Last review	

SCREENING / SIEVING (FS-PRE-001)

Date	December 2014		
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Amendments	Date	Amended by	Modification objective

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1.- INTRODUCTION

Considering raw wastewaters treatment, prior to the treatment itself; they undergo to a series of physical operations which constitute the pre-treatment. The purpose of pretreatment is to separate water from the highest possible quantity of materials coming through the drainage system that, due to its nature and size, are capable to generate troubles like: pipe clogging, equipment abrasion, fouling, deposit coarse sand settling, etc.

Large and medium size residues are removed by pretreatment operations. In general, it is the most annoying and visible pollution from the point of view of the plant operation (large and medium size solids, sand, oil and grease, etc.). Among the elements performing this function bar screening and sieving are considered below.

2.- DESCRIPTION

2.1.- Bar screening

Bar screens are placed in transversal or opposite direction to the water flow, so that water passes through them and solids bigger than bar separation are retained.

In general, bars can be made with a curved or straight (flat) shape. When straight, bars positioning with respect to the horizontal may be vertical or inclined.

The bars can be hand-cleaned or mechanically cleaned

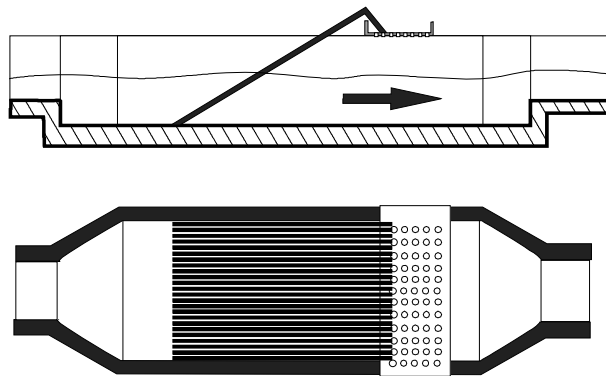


Figure1.- Hand cleaned inclined bar screen.

Mechanically cleaning bars minimize clogging problems and reduce the maintenance time. The cleaning mechanism is usually a mobile rake which periodically sweeps the bars, extracting the retained waste. In curved bars, the cleaning rake has circular mechanic motion.

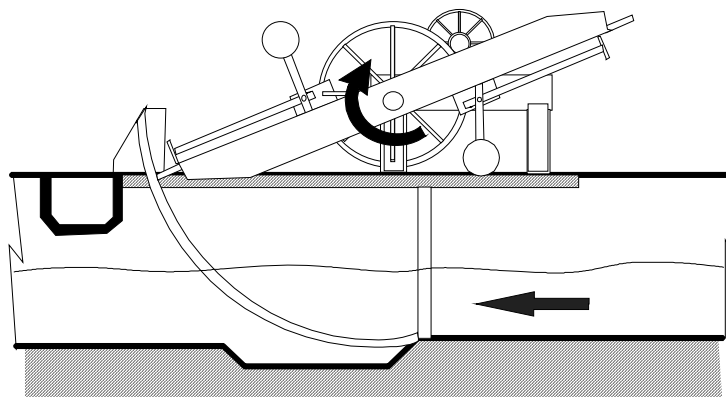


Figure 2.- Curved bars screen with reciprocating rake mechanical cleaning.

If the screen bars are straight, the cleaning rake performs a translational movement based on pneumatic or oleo-hydraulic cylinders, with chains or wire systems. The rake movement can be developed by the screen front or backside. In attendance to the use of cables, it is advisable to periodically check its tension to ensure that during the cleaning cycle the rake reaches the bottom of the bars preventing debris from accumulation.

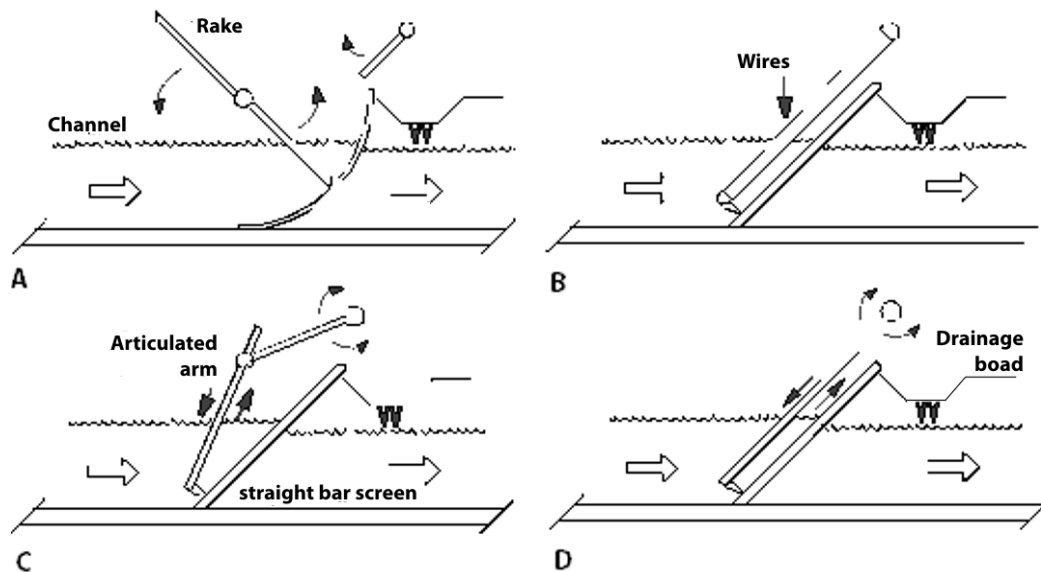


Figure 3.- Mechanically actuated bar screens with backside cleaning. A) Curved bar rack; B) Reciprocating rake; C) Arm rake D) Telescopic rake.

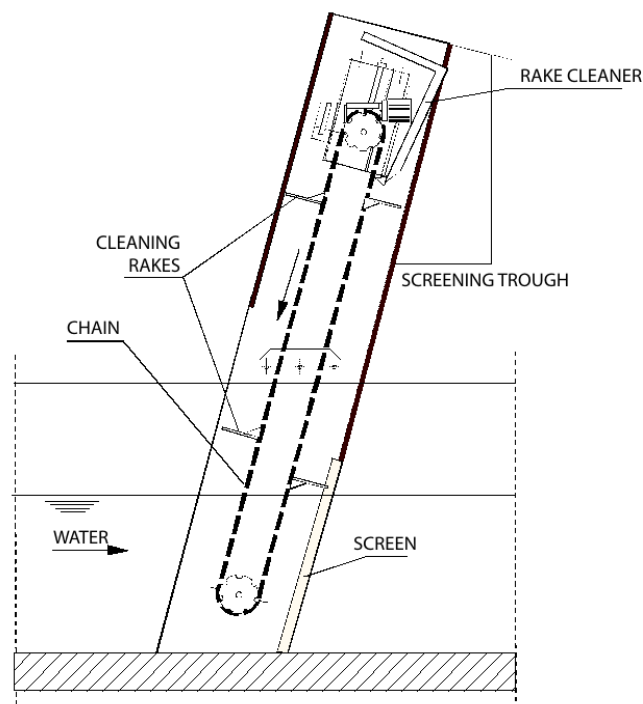


Figure 4.- Front-cleaned, front-return chain-driven mechanically cleaned bar screen.

The automation mechanisms for bars cleaning can be based on: a) clocks or timers, setting the pace for cleaning from the average fouling rate and good practice criteria; b) the head loss that occurs when the bars get dirty. This head loss is reflected in the level variation between the front and rear faces. A level probe upstream and/or downstream sends a command to the cleaning time when the level difference exceeds a certain value. Both systems are commonly complemented.

The extracted residues must be evacuated to a storage area that, depending on the size of the facility, will require transport by conveyor belts or spiral screws. Whatever is the size of the facility, the presence of a compacting element is advisable. In small installations removed residues can be accumulated and drained off on a perforated board.

2.2.- Fine screening (sieving)

Fine screening consists of a filtration through a thin mesh. Sieves are generally self-cleaning electromechanical equipment. Mesh size ranges from 3 to 6 mm in fine screening. The use of these devices often requires the presence of previous screening.

Rotary, screw and steps sieves are essentially distinguished.

The rotary sieves or drum screens are in widespread use (large and small wastewater treatment facilities) due to their easy maintenance and mechanical robustness. It consists of a horizontal axis cylindrical grid or mesh, made of stainless steel, rotating slowly by a motor drive. Removed residues are extracted from the mesh by a fix scraper and disposed into a container.

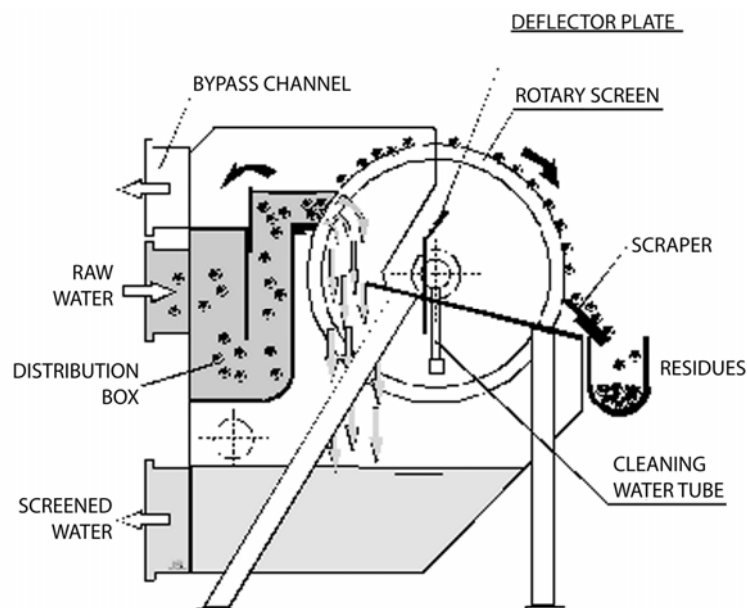


Figure 5.- Rotary screen.

On the screw sieve, the screening is performed through a semi-cylindrical perforated plate. Solids separated from the filtration zone are automatically dumped from the channel by a coreless spiral screw. A spiral brush attached to the lower end of the screw ensures that the filter mesh is continuously cleaned. On the top of the screw, solid compaction is performed and the drained water flows into the channel. The compacted waste can be downloaded directly into containers or bags.

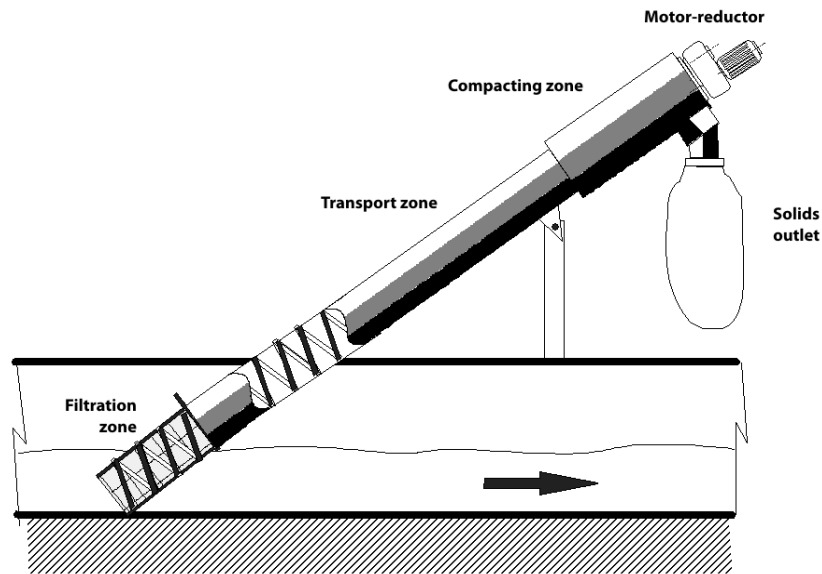


Figure 6.-Screw sieve.

Step screens are of vertical continuous sieving type. This kind of sieves incorporates scrapers on the filtration belt. The arrangement of the scrapers on stainless steel shafts forms a filtering screen that is assembled on a frame-support which is installed directly on the channel. Wastewater solids are captured by the filtering screen, withdrawn by the scrapers and discharged at the top of the unit to the back side of the sieve. The circuit of the mesh belt is disposed in order to be self-cleaned as the scrapers pass between the arms of the next row of elements.

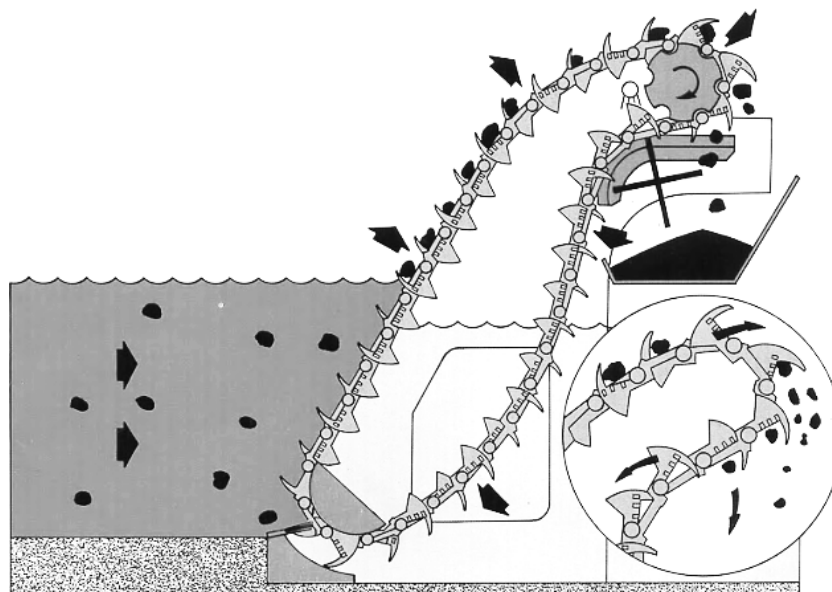


Figure 7.- Self-cleaned step fine screen scheme.

As in bars, extracted residues must be evacuated to a storage area that, depending on the installation size, will require transportation by conveyor belts or screws. Regardless of the size of the installation, the presence of a compaction element is needed.

3.- DESIGN CRITERIA

In the case of electromechanical equipment, bar screens or sieves, design is conditioned by manufacturer's specifications. Normally, the mesh size is given to the provider (average size of the solids to retain), the pretreatment maximum flow, fouling degree requirements, the concentration of suspended solids, and where appropriate, head loss capacity.

However, hand-cleaned bar screens, and their installation channel, are often subject to be designed by the author of the treatment plant project.

3.1.- Bar screening

When the arrival of a treatment plant has a head pumping station, a prior screening unit will be needed, based on bar screens with a bar spacing of 20 or 40 mm. This bar spacing, regardless of the presence of a pumping head tank, should consider the following criteria:

- ✓ If the WWTP owns a head sump, the bar screens spacing will be 40 mm
- ✓ If the WWTP, does not have head sump, bar spacing will be 20 mm.

In any case, bar screening prior to the pumping station are considered as a pretreatment step.

Bars bars must have a minimum thickness like:

- ✓ Bar spacing of 40 mm: thickness between 12 and 25 mm
- ✓ Bar spacing of 20 mm: thickness between 6 and 12 mm

For design objectives, the maximum fouling degree considered is a 30%. The maximum inlet flow will be the design maximum flow for the pretreatment units.

3.2.- Sieving

Sieving equipment technology selection will be based on criteria: maximum treatment flow, suspended solids concentration, mesh size and head loss requirements.

All sieving equipment should be preceded by a previous bar screening.

The design maximum fouling degree will also be 30% and the design flow to be treated equal to the maximum flow coming to the WWTP.

3.3.- Waste storage

The residues are transported (conveyor belts or pneumatic ejectors) to a container usually preceded by a waste compactor. A good practice for waste management is the storage inside closed containers.

Compactors remove water and reduce the volume of waste. They can reduce the water content by 50% and the volume of waste up to 75%.

To prevent debris from falling out of the container, the big heights (more than 1 meter) between the output of compacted waste and the mouth of the container shall be shielded.

There is an easy access to the containers and the ground where they are installed has drainage supply.

For cleaning issues, a water supply point is situated as closest as possible to the compactors and containers area.

4.- PARTICULAR TECHNICAL CONDITIONS

In screening pretreatments, solids removal occurs, and even sand removal can be kept in some sieves. However, it is considered that this does not involve suspended solids, BOD reduction or other pollutant parameters (like bacteriology) from raw water. Thus, in attendance to pollutants discharge control (SS, BOD, etc.) it is considered that pretreatment performance is null.

4.1.- Bar screens

The main requirements in the design and operation are:

- Easy access and security
- Electricity, if they have electromechanical equipment
- Cover containers if they are outdoors.
- The hydraulic load rate through the bar screens must be enough to fix the solids over the bars without and excessive head loss or fouling. In channels with electromechanical bar screens maximum water velocity between bars shall be about 1.2 m/s. The minimum speed is 0.4 m/s so as to minimize the accumulation of sand or other debris by sedimentation.
- The number of channels is determined on the base of the above velocities for the different flow situations. In the area close to the bar screen, the channel is often widened in order to improve the hydraulic performance.
- In screening channels, with hand-cleaned bars, the water velocity should be 0.6 m/s at average flow rate. Cleaning is done with a rake, so it is desirable to install the bar screen with a slope of 50 ° to 60 ° with respect to the horizontal, without a long size.
- Since the mesh size is known, the head loss including design parameters can be calculated. In screening units, head losses up to 0.4 m are allowed.
- As commercial products, the selection of electromechanical bars shall be derived from the provider's technological offer, who will report about the clean bars head loss and operation.
- In motor systems, whose operation involves wires use (bars screens with screenings trough), there will be provided with a tension control system. The motors are provided with torque limiter.
- When the bar screens are high, greater than 3 meters, they will have multiple cleaning rakes to prevent clogging.
- Cleaning rakes should be perfectly adjusted to the bar spacing and be easily replaceable.
- All channels roughing provided with gates to be isolated, if needed, in every possible hydraulic conditions.

4.2.- Sieves

All screens are provided with gates to be isolated, if needed, in every possible hydraulic conditions.

4.3.- Waste compactor

The wastes compactor is equipment whose capacity depends on the estimation of the maximum waste production.

In pipe transportation of compacted waste, the presence of elbows must be avoided as they use to generate pipes clogging.

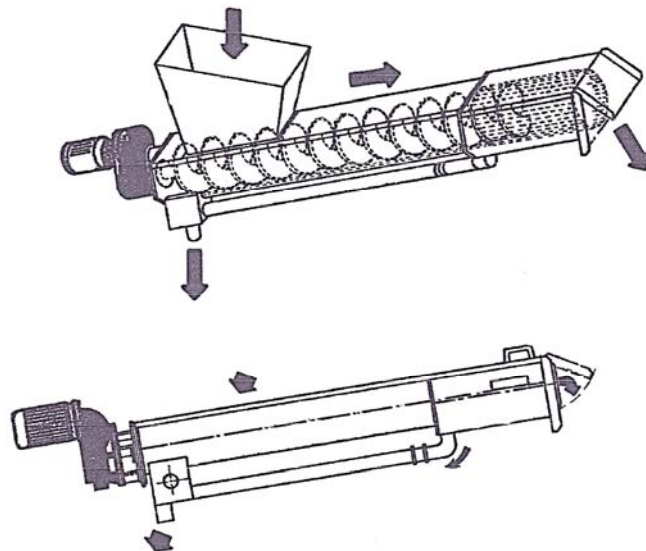


Figure 8.- Operating scheme of a screening unit waste compactor.

5.- CONTROL PARAMETERS AND OPERATION STRATEGIES

Hand-cleaned bar screens:

- Hand cleaning takes place by raking, depositing removed waste at perforated troughs provided for that purpose, to get waste drainage prior to its collection in a container and the subsequent convey to the landfill.
- When wastes build up clog the channel, they cause wastewater to leave the manholes or recede to entrance sewage pipe. Cleaning frequency should be at least twice a day, but experience in operation will set the proper operation rate.

Mechanically cleaned bar screens

- Checking the waste removal degree of bar screens.
- Inspection of bars fouling. If it is foul, clean it before it gets blocked.
- Cleaning bars, and where appropriate, conveyor belts or screws.
- Check lubrication level.
- Monitoring the container filling level
- Electromechanical operation inspection.

When deposits are found at the bottom of the channels where bar screens (hand or mechanically cleaned) are located, they should be extracted and sent to landfill.

Sieves:

- Checking the waste removal degree of sieves
- Cleaning sieves, and where appropriate, conveyor belts or screws.
- Notice for waste transport if necessary.
- Check lubrication level.
- Checking the degree of clogging of the waste press.
- Monitoring the container filling level
- Inspection of screen clogging and, if clogged, clean it before it gets blocked
- Electromechanical operation inspection.

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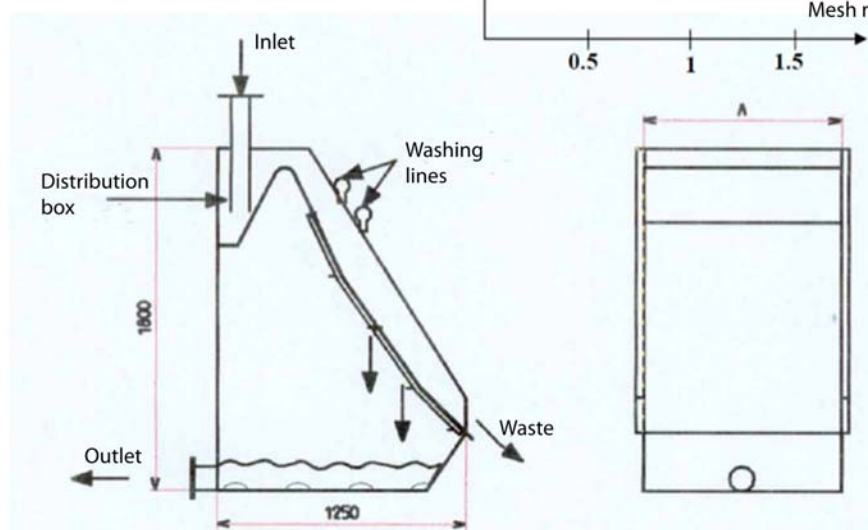
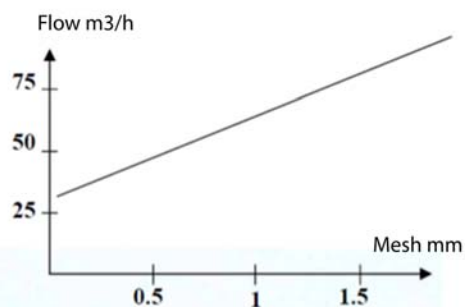
ANNEX 2

AREA REQUIREMENTS ESTIMATION

SCREENING SYSTEMS AREA REQUIREMENTS ESTIMATION

DIMENSIONS

MODEL	MESH SIZE mm	A	WHEIGHT kg
SERTIS 05	500	580	152
SERTIS 10	1000	1080	212
SERTIS 15	1500	1580	292
SERTIS 20	2000	2080	331



Water flow rates (m³/h) for rotary screens

		MESH PORE SIZE (MM)								
		0,15	0,25	0,50	0,75	1	1,50	2	2,50	3
ROTARY SCREEN MODEL	AMN 2450	8	12	20	25	30	40	47	52	55
	AMN 4050	19	30	50	71	77	98	113	125	135
	AMN 4080	31	49	86	115	124	158	183	202	217
	AMN 4100	44	58	100	138	148	188	220	240	260
	AMN 6050	33	51	90	120	130	166	192	212	228
	AMN 6100	47	107	188	251	271	345	400	442	475
	AMN 6150	104	163	286	382	413	525	608	672	722
	AMN 6200	139	219	384	513	554	705	817	902	970
	AMN 9150	151	237	415	554	599	762	883	975	1.048
	AMN 9200	202	318	557	744	804	1.023	1.185	1.309	1.407
	AMN 9250	254	399	699	934	1.009	1.284	1.487	1.643	1.217
	AMN 9300	303	477	836	1.116	1.206	1.535	1.777	1.963	2.110
	AMN 12300	362	575	1.024	1.386	1.473	1.910	2.244	2.507	2.719
	AMN 12400	471	747	1.332	1.802	1.914	2.484	2.917	3.259	3.534

This box includes treatment capacities references for rotary sieves calculated for water with a content up to 350 ppm of suspended solids, such as urban waste water, canning industry, etc.

Technical characteristics of the rotary sieves

MODEL	CILINDER DIAMETER MM	CILINDER LENGTH MM	MOTOR POWER KW	EMPTY WHEIGHT KG	TOTAL WIDTH MM	TOTAL DEPTH MM	TOTAL HEIGHT MM	INLET FLANGE MM	OUTLET FLANGE MM
AMN 2450	240	490	0,18	80	700	600	480	100	100
AMN 4050	400	490	0,25	110	720	815	725	150	200
AMN 4080	400	790	0,25	160	1.020	815	725	200	250
AMN 4100	400	960	0,25	190	1.220	815	725	200	250
AMN 6050	630	460	0,55	260	831	1.269	970	200	250
AMN 6100	630	960	0,55	300	1.331	1.269	970	250	300
AMN 6150	630	1.460	0,75	340	1.831	1.269	970	300	350
AMN 6200	630	1.960	0,75	400	2.331	1.269	970	350	400
AMN 9150	915	1.460	1,00	1.100	1.900	1.623	1.255	400	500
AMN 9200	915	1.960	1,00	1.250	2.400	1.623	1.255	500	600
AMN 9250	915	2.460	1,50	1.400	2.900	1.623	1.255	2x350	Libre
AMN 9300	915	2.960	1,50	1.550	3.400	1.623	1.255	2x400	Libre
AMN 12300	1.200	2.940	2,20	2.650	3.235	2.250	1.926	2x600	Libre
AMN 12400	1.200	3.940	2,20	2.650	4.500	2.250	1.926	2x750	Libre

Source: Aguas del Mare Nostrum

<http://www.tratamientosdelaguaydepuracion.es/tamiz-rotativo-pretratamientos.html>



ANNEX 3

GRAPHIC DESCRIPTION OF PROCESS UNITS



Figure 1
Basic bar screen system with box to collect and remove wastewater



Figure 2
Basic bar screen system with box to collect and remove wastewater



Figure 3
Coarse bar screen with coupled chain rakes cleaning system



Figure 4
Double screening system. Basic hand-cleaned screen and mechanically cleaned system.



Figure 5
Coarse bar screen with mechanically cleaned system.



Figure 6
Curve bar screen with mechanically cleaned system



Figure 7
Fine curved bar screen with mechanically cleaned system



Figure 7
Fine curved bar screen with mechanically cleaned system

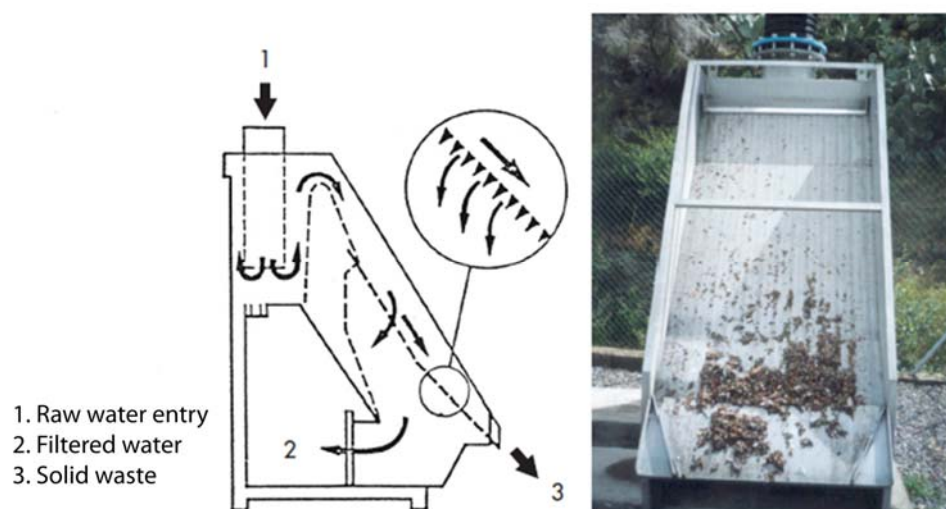


Figure 8
Static sieve

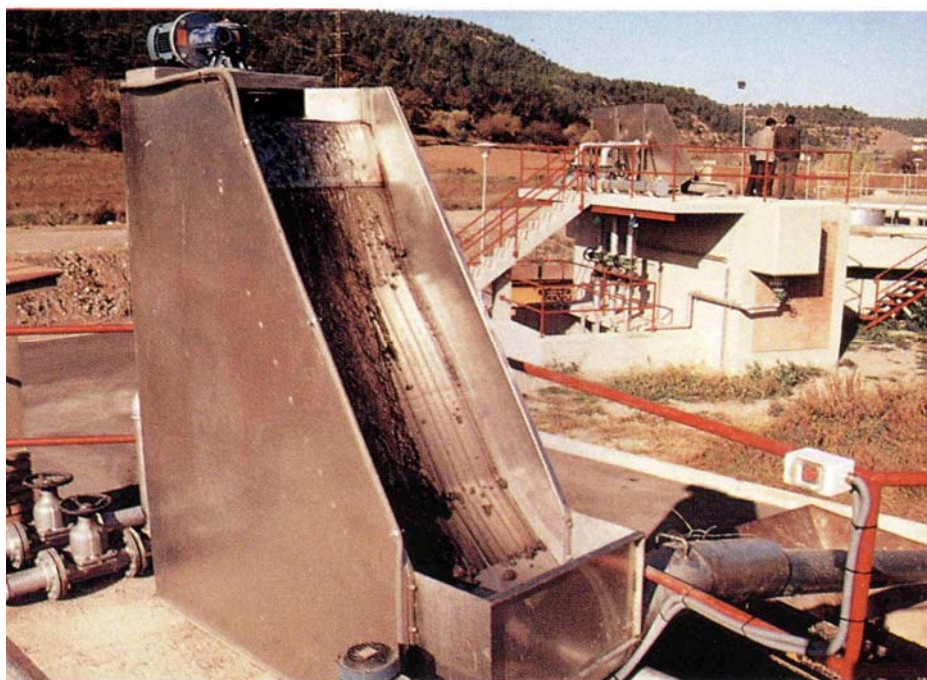


Figure 8
Static sieve

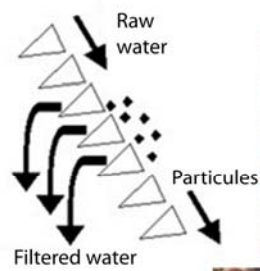


Figure 9.
Static sieve system detail



Figure 10
Static sieve

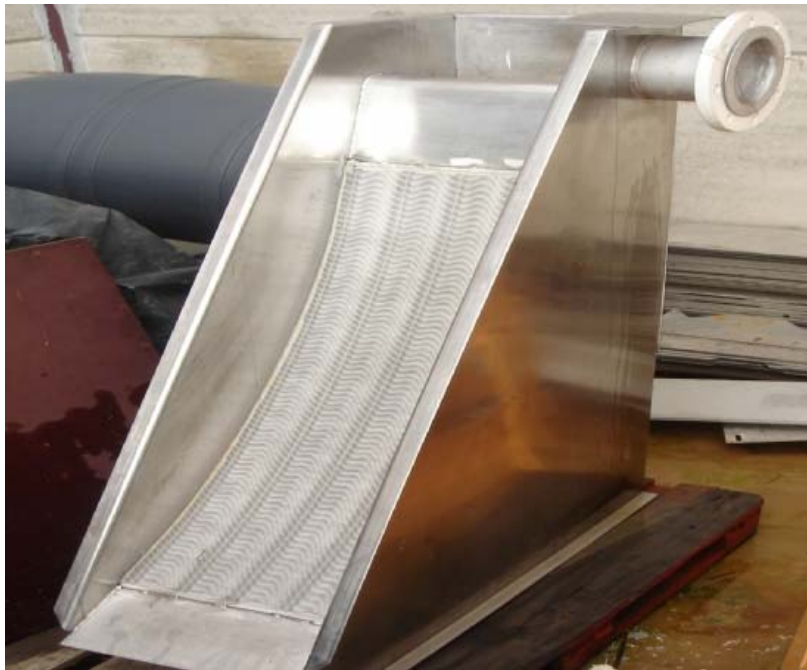


Figure 11
Static sieve

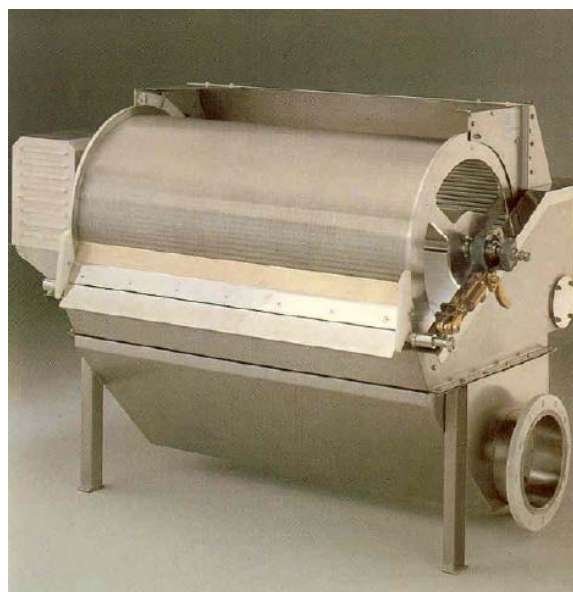


Figure 12
Rotary or drum sieve.

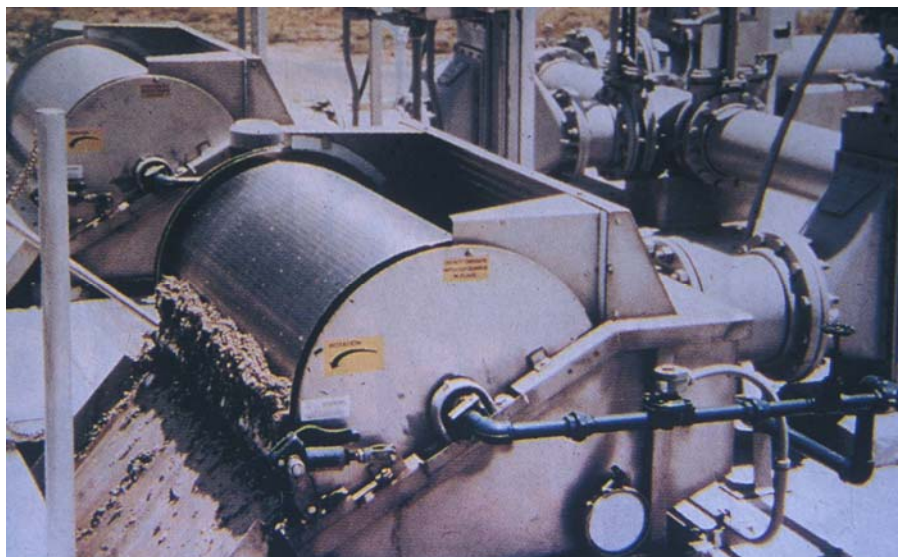


Figure 13
Rotary or drum sieve.



Figure 14
Detail of supply and screened water in a rotary screen.



Figure 15
Cover system for a rotary sieve.



Figure 16
Rotary sieve mesh detail



Figure 17
Rotary sieve mesh detail



Figure 18
Rotary screens configuration



Figure 19
Rotary screen waste outlet detail



Figure 20
Small and compact rotary screen application

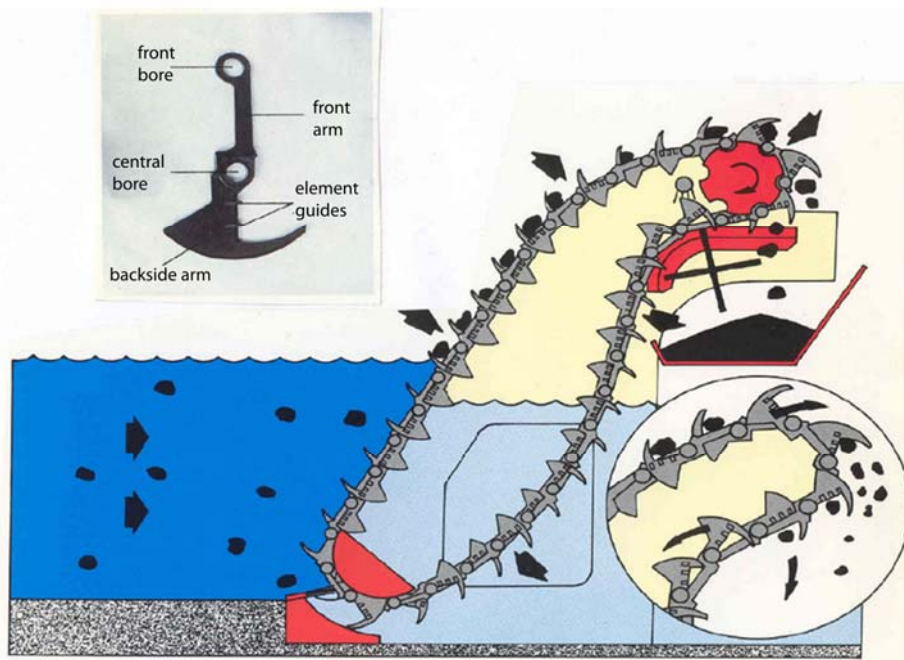


Figure 21
Operation diagram of a sliding screen.



Figure 22
Overview of a sliding screen



Figure 22
Overview of a sliding screen

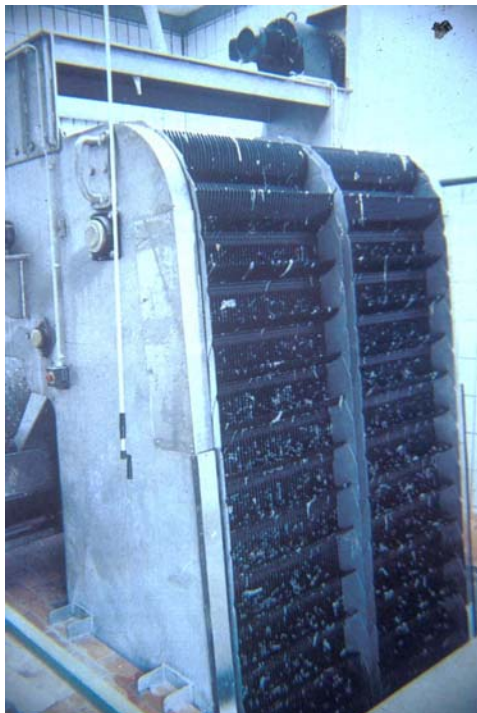


Figure 22
Overview of a sliding screen

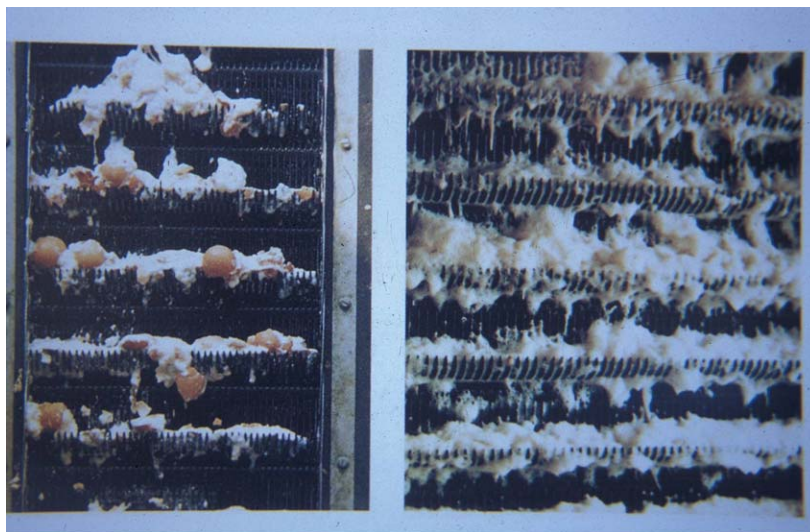


Figure 23
Overview of waste removed by a sliding screen.



Figure 24
Overview of waste removed by a sliding screen.

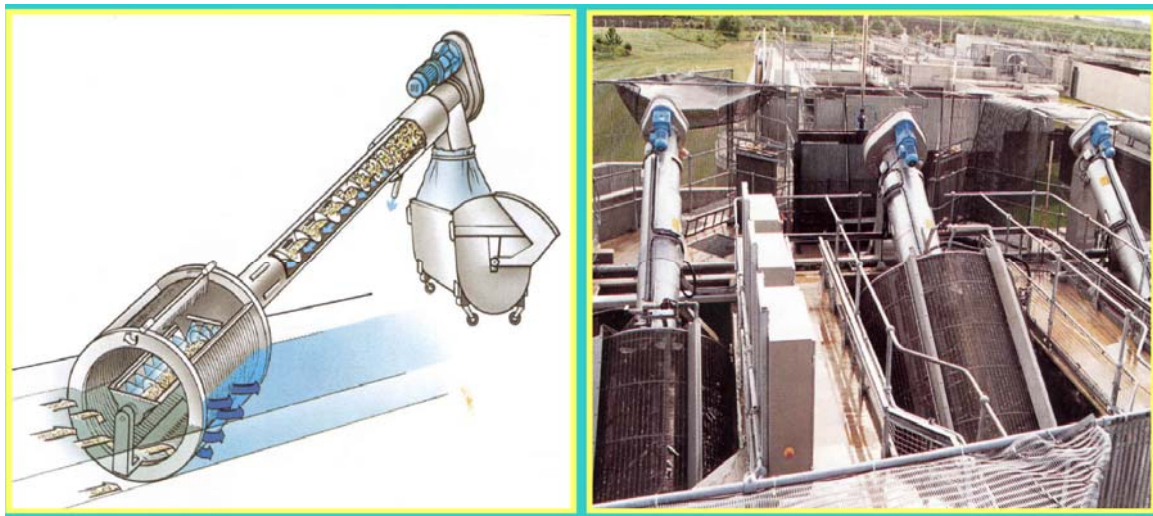


Figure 25
Screw sieves

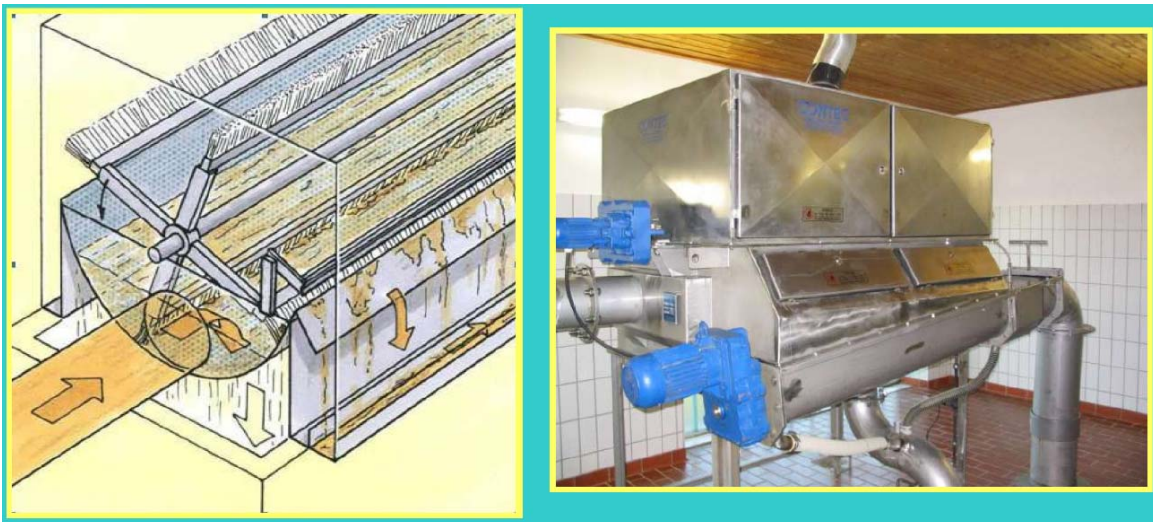


Figure 26
Semi-circle bed Sieves.



Figure 27
Waste drive system based on coreless screw.



Figure 28
Waste drive system and compaction based on Archimedes screw



Figure 29
Piston based waste drive system and compaction

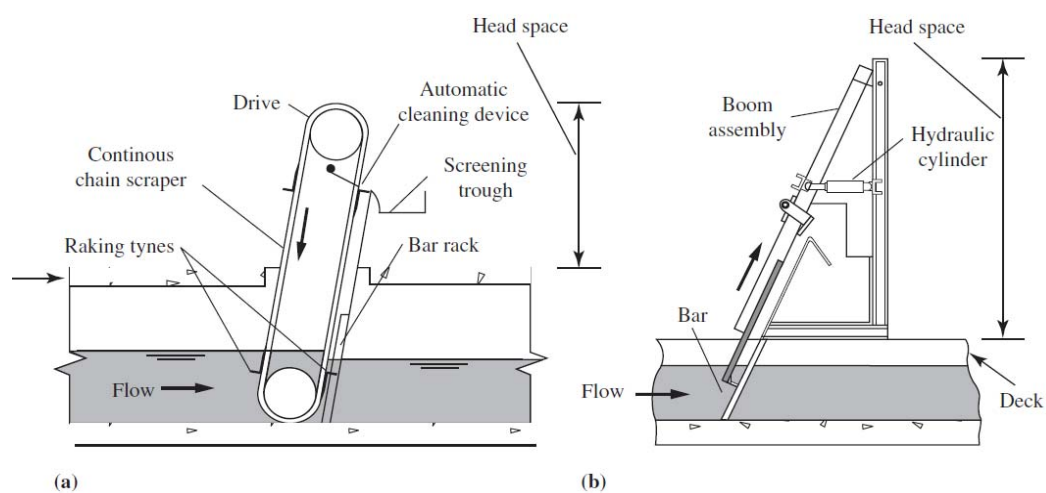


Figure 30
Typical mechanically cleaned coarse screens: a) front-cleaned, front-return chain-driven; reciprocating rake (Metcalf & Eddy, 2002)

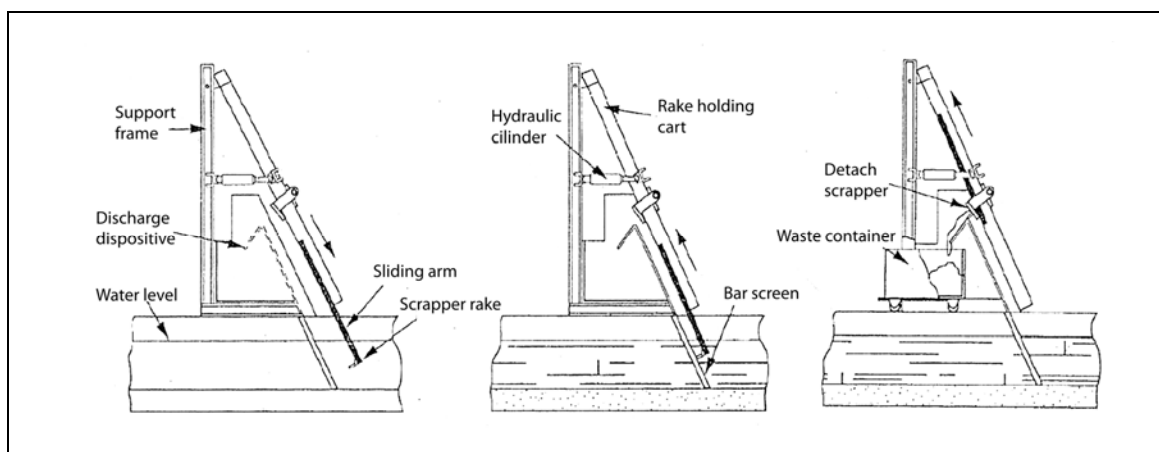


Figure 31
Mechanically cleaned coarse screen operation

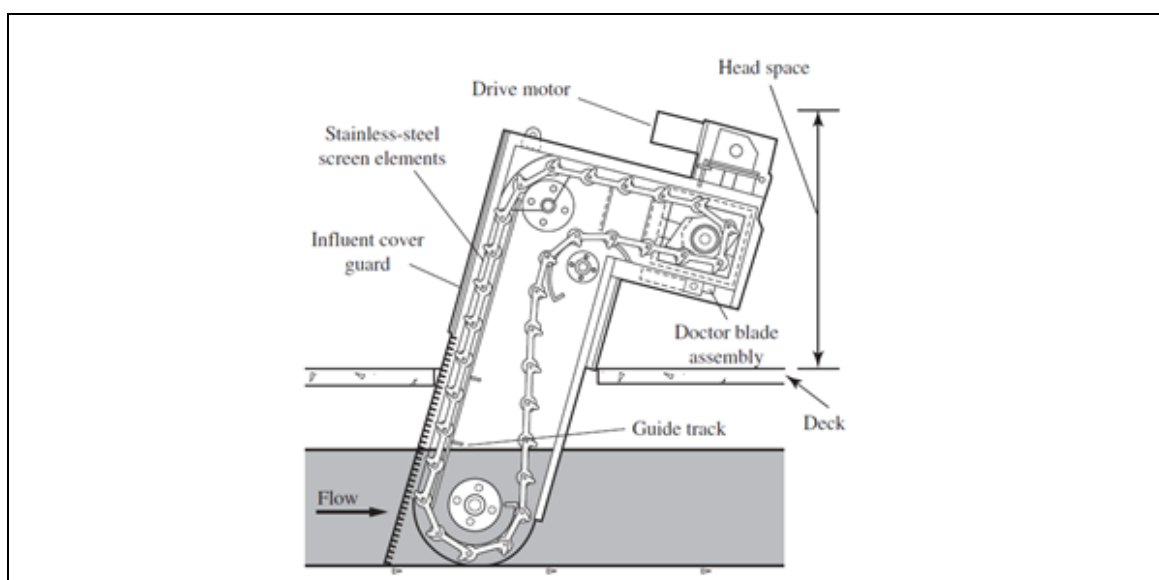


Figure 32
Sliding screen scheme

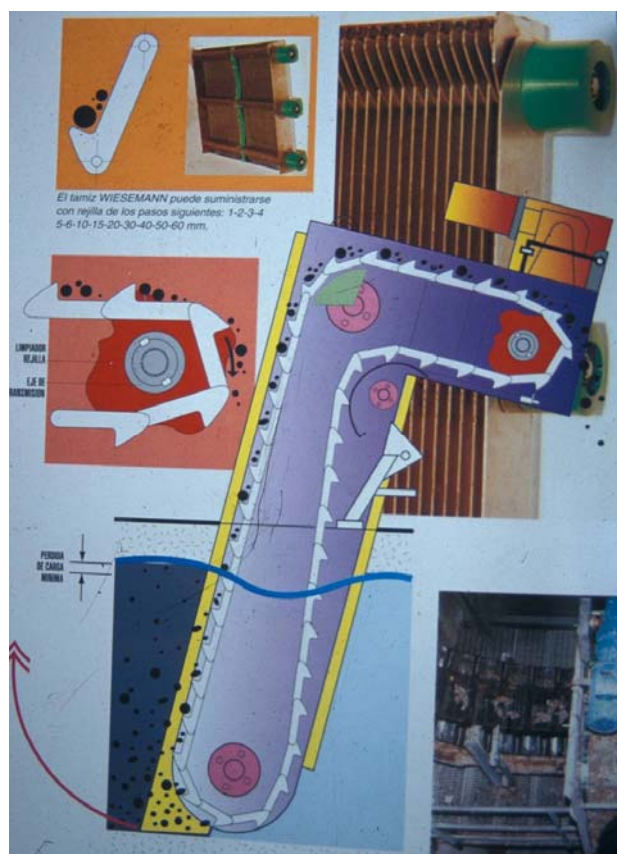


Figure 33
Wiesseman® sliding screen

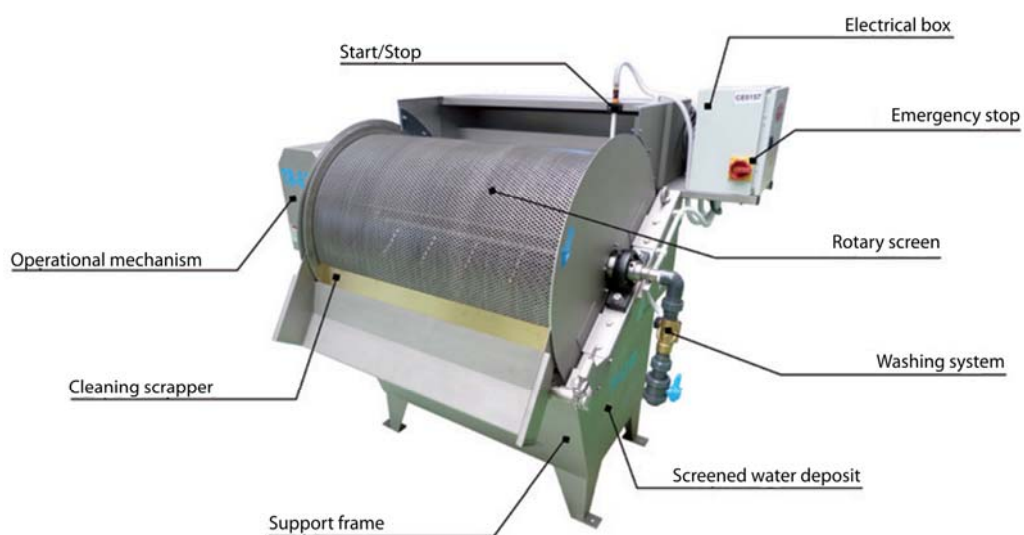


Figure 34
Rotary screen scheme

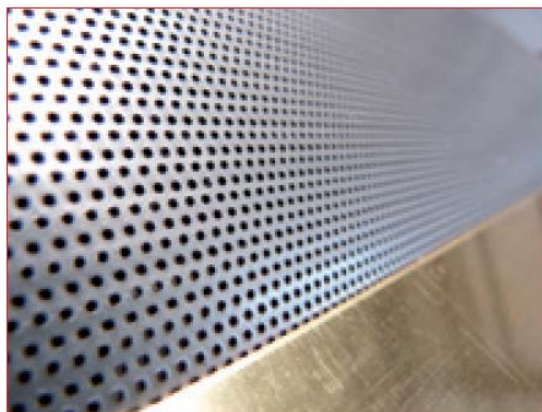


Figure 35
Bar mesh (up) and pore mesh (down) detail for sieving units