Developing and emerging countries frequently discharge their wastewater from coastal areas to the sea. These marine outfalls are systems that comprise three stages: wastewater treatment, discharge and distribution. Wastewater treatment is always the first step of a marine outfall and sets the course for successful wastewater disposal. The importance of wastewater treatment is reflected in the fact that nowadays more plastic articles are discharged to the sea than fish is harvested.

Biological wastewater treatment projects are frequently put on hold due to their enormous investment costs, increased energy demand (high operating costs) and a high level of plant attendance required from operating staff. Mechanical treatment systems, in contrast, represent a fast to implement, cost-effective and safe solution for the removal of undissolved matter from wastewater flows. Especially new developments in the field of ultra-fine and micro screening with very fine apertures of below 1.0 mm further improve the quality of discharged wastewater and can be tailored to meet various specific requirements.

DIFFERENT REQUIREMENTS ON MECHANICAL WASTEWATER TREATMENT FOR MARINE OUTFALLS

1. Removal of sanitary and plastic products

If the receiving water body is able to cope with high organic loads and ensure the distribution and quick dilution of the discharged wastewater, the wastewater treatment systems for marine outfalls are in most cases only required to remove coarse material, such as sanitary and plastic products.

The process technology of such treatment plants consists in most cases of a coarse material screen, grit trap and fine screen. Examples of plant installations can be seen at Cartagena (Colombia), La Taboada (Lima), or Coquimbo (Chile).
The basic element of this concept is fine screening. Fine screens used for the requirements of plastic and sanitary product removal normally have bar spacings between 1.5 and 0.75 mm. The average COD load reduction for example achieved by a 1.0 mm screen is 5% to 10%. Filterable solids can be reduced by about 10% to 30%. The ROTAMAT® Rotary Drum Fine Screen Ro2 is especially suitable for this purpose as it combines in one unit the process steps of screening, screenings washing, transport, dewatering and discharge. Furthermore, due to the inclined installation of the screen basket, an overproportionally larger screening surface can be submerged and utilised with rising water levels. The overproportionally large available screening surface leads to reduced flow velocity through the screen basket gaps with the result of improved separation efficiency and lower hydraulic losses compared to other systems.

2. Finer screens meet higher effluent quality requirements
Where effluent quality requirements are higher due to sensitive or already heavily loaded waters and fine screens are insufficient, ultra-fine screens are used to clarify the water. These screens are equipped with a two-dimensional screening surface, i.e. a mesh or perforated plate. Contrary to one-dimensional screening elements, such as a wedge wire, the apertures of a mesh or perforated plate are defined in two directions. This gives a defined separation size and ensures extensive removal of solids. Very fine screen openings from 0.2 mm to 1.0 mm are necessary to separate high oxygen-consuming loads. Despite their fine apertures, especially machines with a filter mesh are able to cope with high throughputs due to the large free surface offered by the mesh. Screens with mesh sizes from 0.2 mm to 1.0 mm achieve a COD reduction of up to 30 % and AFS reduction of up to 60 %. The higher the ratio of undissolved / dissolved COD, the higher is the percentage of COD separation efficiency as only undissolved substances can be removed by a mechanical screen if no chemicals are added.

Well-proven screens have an installation angle of 30 %, or are horizontally installed drum screens. They are often used as preliminary screens for membrane wastewater treatment plants, primarily for the removal of hairs and fibres which otherwise could cause severe problems in the downstream membrane plant. The screenings separated by such very fine screens consist of significantly smaller particles than screenings from coarser screens and can even be composted if sanitary and plastic products have been removed by an upstream preliminary screen.

The performance of the screens can be increased if chemicals are added. Especially if there is the danger of eutrophication of the receiving water body due to the high amount of discharged nutrients, COD and especially phosphorus in the effluent can further be reduced by adding precipitants and flocculants. Precipitation is the conversion of dissolved material (mostly ionic) contained in wastewater into a particulate form in a chemical reaction. The dissolved matter is converted into hardly soluble substances that can be converted into mechanically separable particles (macro flocks) through addition of flocculants. If flocculants are added, filterable solids can be reduced by up to 95 %, COD/BOD by 65 % and phosphorus by 60 %.

3. Advanced wastewater treatment: micro screening

If a virtually solids-free effluent and as extensive as possible COD reduction is required, this can cost-effectively be achieved with the installation of a downstream micro screening plant. New technical developments allow for the use of filtration technologies known from tertiary wastewater treatment also for the purely mechanical treatment of wastewater. Filter disc technology is especially suitable for this purpose due to its simplicity, small space requirements, reliable separation performance and the large available filter surface that allows for high throughputs.

A solids reduction of up to 60 – 80 % can be achieved with filter sizes as small as 20 micron.

Combined chemical and mechanical treatment, i.e. with the addition of flocculants and use of micro screens, is able to reliably and cost-effectively achieve outlet concentrations of below 50 mg/l even with screen apertures not smaller than 50 micron (95 % AFS reduction possible). Compared to the combined system of fine screening with the addition of precipitants and flocculants, the chemicals consumption of micro screens is significantly lower due to the much smaller filter size and therefore much lower requirements in terms of floc stability and shearing strength. Although the investment costs for micro screens are higher than for fine or ultra-fine screens, they are still lower than for biological treatment solutions.

CONCLUSIONS

New concepts need to be developed in view of the fact that the biological wastewater treatment systems we know from industrialised countries are not suitable to solve the problems in rural areas or developing and emerging countries. New mechanical wastewater treatment concepts are able to meet the requirements of adapted wastewater treatment solutions. A variety of mechanical wastewater treatment systems is available for different clarification requirements and intended purposes of use.

The range of available solutions includes systems for the separation of sanitary and plastic products but also for finer screening up to micro screening plants for the extensive removal of solids. A virtually solids-free effluent can be achieved if flocculants are added. Chemical consumption strongly depends on inlet concentration and screen apertures. The smaller the openings of the screenings elements are selected, the lower is chemical consumption. Mechanical wastewater treatment plants offer the additional advantages of low investment and operating costs and low maintenance requirements compared to biological treatment systems.

WORLDWIDE REFERENCE INSTALLATIONS OF MECHANICAL WASTEWATER TREATMENT SOLUTIONS FOR MARINE OUTFALLS:

- La Taboada (Lima): coarse screening with 8 RakeMax® screens, L = 3300 mm, W = 2752 mm, 6 mm bar spacing, screenings treatment with launder channel and connected WAP-SL wash press, fine screening with 22 ROTAMAT® Rotary Drum Fine Screen Ro2 units with 3000 mm diameter and 1.0 mm aperture
- Cartagena (Columbia): Fine screening with 6 ROTAMAT® Rotary Drum Fine Screen Ro2 units with 2600 mm diameter and 1.5 mm aperture
- Coquimbo (Chile): 6 Complete Plant Ro5 units equipped with ROTAMAT® Rotary Drum Fine Screen Ro2 units with 1200 mm diameter and 3 mm aperture
- Qinghe (China): 16 Rotary Drum Screen RoMesh® units size 6 (1600 mm dia. 3000 mm long) with 0.2 mm mesh

- Screens and Fine Screens
**Related Products:**
- Ultra Fine Screens
- Microscreens
- HUBER Drum Screen RoMesh®
- HUBER Rotary Drum Fine Screen / Perforated Plate Screen - ROTAMAT® Ro2 / RPPS / STAR
- HUBER Membrane Screen ROTAMAT® RoMem
- HUBER Disc Filter RoDisco®
- HUBER Multi-Rake Bar Screen RakeMax®

**Related Solutions:**
- HUBER Solutions for Removal of very fine Solids by Micro-Screening and Filtration
- HUBER Solutions for Mechanical Pre-Treatment