Improving the quality of wastewater

Biodegradation as the key to successful wastewater treatment

Water is precious. For this reason, Voith Paper has the aim of consuming less process water in paper production. It only works with the aid of effective wastewater treatment – and this is different in every paper mill.

Whether a paper manufacturer produces graphic paper or packaging, whether it uses recovered paper or fresh fibers and whether it conveys the wastewater from paper production into a municipal clarification facility or directly into a body of water – all that has a decisive effect on its wastewater treatment plan. Voith Paper Environmental Solutions (VPES) has by now a broad portfolio of technologies and offers solutions for all kinds of wastewater treatment.

The initial situation is decisive

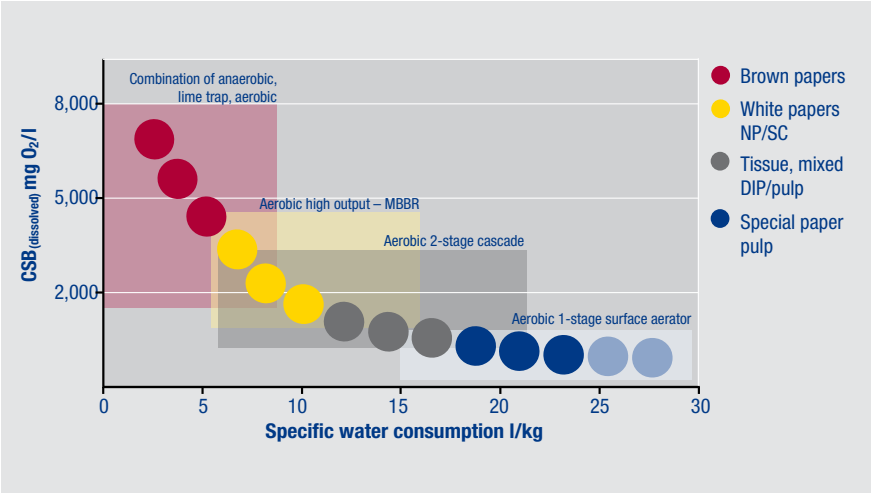
The requirements for a wastewater system depend on certain parameters. First, the amount of wastewater must be determined. This results from the specific water consumption and the production output. Organic contamination of the water is measured in COD (chemical oxygen demand) or BOD (biochemical oxygen demand), which both depend heavily on production processes and the use of raw material. In addition, the raw material used influences the wastewater, which is why the input quantity into the stock preparation and the specific organic contaminant load quantity of the raw material are viewed as essential parameters. The final contaminant load in the water results from the input quantity minus the contaminant load discharged with the rejects, residual materials and the paper that is produced. The kind of wastewater discharge also plays a big role in the selection of a wastewater plan. Depending on the requirements of authorities, paper mills can discharge the wastewater indirectly into a municipal clarification facility or as direct dischargers into a body of water, e.g., a river, after complete treatment. The engineers at VPES prepare an individual plan for each paper mill with balancing software specifically developed for this and with 3-D engineering tools. The result is a process technology that is optimized for the respective paper mill.

Four main process groups

Most wastewater systems consist of the four main process groups of preliminary treatment, biological stage, secondary treatment and sludge treatment. In some cases, wastewater cooling or an additional process group is required as a third treatment stage.

In preliminary treatment, it is a matter of removing contaminants and solids from the wastewater with the aid of rake classifiers, disk thickeners (Elephant filters), micro-flotation or sedimentation (Zenith series). For mechanical and chemical-physical

The R2S reactor at Daehan Paper in Korea.



Water consumption and COD load for paper production with correlation of biological treatment processes. The possible ranges of use for typical wastewater treatment processes are indicated in color and differ essentially with regard to investment costs, operating costs, space requirements, and technical design, which also explains the overlapping of the processes. Reduction of the specific water consumption generally leads to more demanding treatment processes.

preliminary treatment, VPES can implement the most varied processes with its own technologies. Optimal process temperatures are produced through direct or indirect cooling.

At the biological stage, anaerobic processes (without oxygen) and modern aerobic processes or also high-rate processes are used, e.g., with substrates. The anaerobic stage always generates a biogas that is treated with a chemical or biological gas scrubbing for further recovery. For anaerobic treatment, VPES developed the 2-stage R2S anaerobic reactor with internal and external recirculation, which is especially suitable for wastewater that is organically heavily loaded and also has a high lime load. Since the R2S anaerobic reactor came on the market in the summer of 2007, it has already proven itself in various countries. Other technologies for the anaerobic stage are the E2E reactor for the mid-load range and cost-efficient UASB modules for retrofitting and conversion of existing systems.

After the anaerobic stage, a stripping reactor and the lime trap remove the lime. For aerobic treatment of the wastewater, either the process of high-rate carrier biology (moving bed bio-reactor – MBBR) or conventional activated sludge process with fine-bubble, coarse-bubble or jet aeration, or also with surface aeration is used. Secondary treatment of wastewater takes place by means of sedimentation with suction rakes. Then the process sludge has to be treated. It is mixed with primary sludge and a small portion of bio-sludge and reaches the pre-dewatering designed, for example, as a gravity table. It is pressed in downstream filter band presses or screw presses. With bio-sludge or mixed sludge with a high biological portion, centrifuges are recommended.

Wastewater treatment in practice – three examples

Different amounts of water and organic contaminant loads make projecting a wastewater system an ever-changing challenge. Parameters such as the production quantity, the raw material used, the specific water consumption and the legal and local general requirements are decisive. Three examples show which solutions VPES has available in its own portfolio.

Example 1: Graphic paper: Newsprint/SC based on 100% recovered paper

System parameters:

- Production: 1,000 tons/day
- Recovered paper input: 1,450 tons/day
- Specific COD load of the raw material: 15-24 kg/ton
- Specific water consumption: 8-12 liters/kg

The results for the wastewater are:

- Amount of water: ca. 11,000 m³/day
- COD load: 28 tons/day (corresponds to a concentration of ca. 2,500 mg/liter)

VPES wastewater treatment plan:

- Preliminary treatment: with Smart Loop consisting of Elephant disk thickener and micro-flotation; counter-flow cooling downstream
- 2-stage activated sludge process with upstream MBBR as high-rate stage (substrate biology)
- Secondary treatment: sedimentation with suction rake
- Sludge treatment: sludge thickening with the aid of pre-thickening, filter band presses, screw extrusion presses or centrifuges

Example 2:
Special paper on the basis of pulp
System parameters:
- Production: 400 tons/day
- Pulp input: 400 tons/day
- Specific COD load of the raw material: 5-8 kg/ton
- Specific water consumption: 15-20 liters/kg

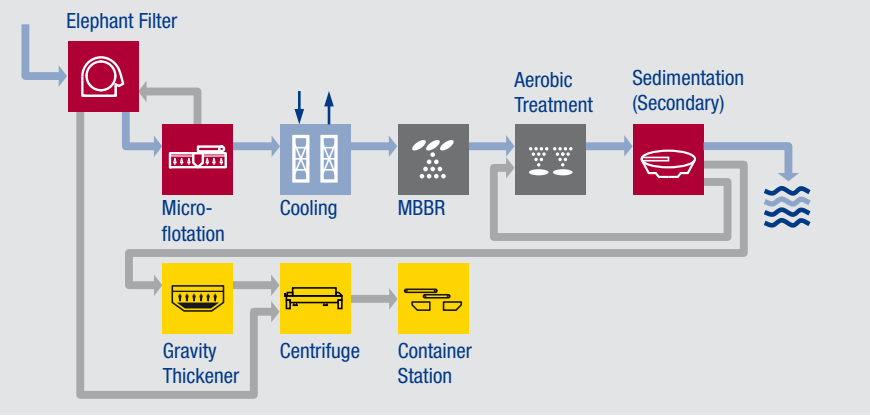
The results for the wastewater are:
- Amount of water: ca. 6,500 m³/day
- COD load: 3 tons/day (corresponds to a concentration of ca. 500 mg/liter)

VPES wastewater treatment plan:
- Preliminary treatment: by means of flotation
- Biological stage: aerobic 1-stage activated sludge biology, e.g., with surface aerators
- Secondary treatment: conventional sedimentation

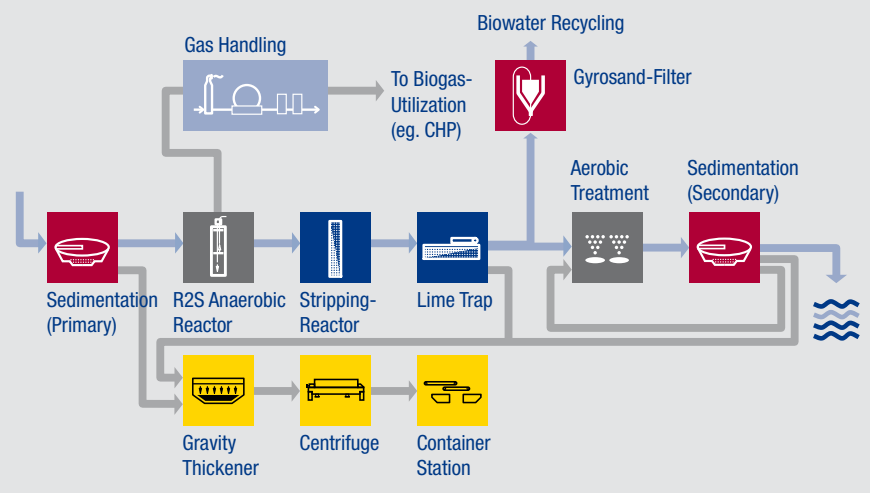
Example 3: Packaging paper, based on 100% recovered paper
System parameters:
- Production: 1,300 tons/day
- Recovered paper input: 1,450 tons/day
- Specific COD load of the raw material: 25-30 kg/ton (ca. 36-40 tons/day)
- Specific water consumption: 3-5 liters/kg

The results for the wastewater are:
- Amount of water: ca. 5,200 m³/day
- COD concentration: 7,000-10,000 mg/liter

VPES wastewater treatment plan:
- Preliminary treatment: conventional sedimentation (shield scraping) or Smart Loop (see Ex. 1), cooling due to the low specific water consumption
- Biological stage: preliminary acidification with anaerobic biological high-rate process (R2S anaerobic reactor), lime trap for lime elimination, aerobic activation biology as second biological stage
- Secondary treatment: sedimentation with suction rake or shield scraper
- Sludge treatment: sludge thickening via pre-thickening and filter band presses, screw extrusion presses or centrifuges



Example 1: Wastewater treatment for graphic paper production.



Example 3: Wastewater treatment for packaging paper on the basis of 100% recovered paper.

On Focus: Wastewater concept

ProRunnability ++++
ProQuality ++
ProSpace +++

Section: total paper machine
Width: all
Paper grade: all

Contact

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