When dairy industry discharges wastewater to municipal sewers – What should you know?

Photo: Valio Oy, Riihimäki R2-facility, © Juho Hannus.

BEST
Better Efficiency for Industrial Sewage Treatment

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Basic facts

The dairy industry can roughly be divided into two groups based on their products

- Fresh product dairies produce milk and cream as well as different kinds of soured-milk products such as yoghurt and curdled milk
- Cheese factories produce cheese, and often also process the whey generated as by-product in cheese production

Main process steps and intermediate products generating wastewaters

- **Interface milk**
  The wastewater loads generated by the dairy industry consist mainly of so-called "interface milk", which is the watery milk that is generated in diluted water/product interfaces in the beginning and at the end of the process. Most dairies convey all "interface milk" to the sewer but separate the fractions with the highest milk concentrations and deliver them further to be used as fodder.
- **Washing of tanks, pipelines and equipment**
  Another significant loading is generated by the initial washing of tanks, pipelines and process equipment. Especially the initial washes of viscose and fatty products can create substantial loading. In the production of liquid products, the wastewater loading is usually at its lowest level but the production of viscose and fatty products can have very high loading. On average ca 50–90% of water consumption in the dairy industry is generated through washing water.
- **Whey**
  Whey is the liquid remaining after milk has been curdled and strained. It is a byproduct of cheese making.

Wastewater from dairy industry

Content and quality of dairy wastewater

- **Organic loading**
  Milk fat is not easily biodegradable. A high chemical and biological oxygen demand is typical for wastewater from the milk processing industry. Typically, the COD concentration in dairy wastewater can vary between 2 000–4 500 mg/l but it can be even higher, depending on the variety of the production.
  - » High BOD and solids content can affect the municipal WWTP process and pre-treatment of dairy wastewater is needed to lower the content.
- **pH value**
  The pH value of dairy wastewater can vary. The pH value of wastewater depends on the processes, used detergents and disinfectants. Dairy wastewater can also sour by itself as a result of its natural fermentation. Mainly sodium hydroxide (lye) and nitric acid are used as cleaning chemicals. Sodium hypochlorite, as well as hydrogen peroxide and peracetic acid mixtures are used for disinfection.
  - » Variations in the pH value is challenging for the municipal WWTP and pH peaks may affect negatively on the treatment process.
  - » In a concrete sewer, a low pH level (pH<6) in wastewater causes corrosion to the sewer network and concrete pumping stations. The pH limits of wastewater conveyed to the sewer vary in general between 6–11.
  - » Pre-treatment of dairy wastewater is needed to stabilize the pH.
- **Temperature**
  The temperature of industrial wastewater can be very high and vary. A high temperature can result from high temperatures used when cleaning the equipment.
  - » A high temperature can cause odour emissions when conveying wastewater to the sewer and produce corrosive compounds under anaerobic conditions. It may also damage plastic sewer network.
  - » High temperature makes fat liquid and when the temperature decreases fat may block sewer pipes, affect the capacity of the network or cause damage to wastewater treatment plant. This should be taken into account when using the grease trap.

Pre-treatment and monitoring of dairy wastewater

Dairy wastewater often requires pretreatment prior to conveying it to the sewer. The dairy wastewater also needs to be monitored for BOD7 or BOD5, COD-Cr, total nitrogen, total phosphorus, solids, pH and fat concentration, among others. Limit values for these parameters should be set in the industrial wastewater contract. When monitoring the wastewater from dairy industry, it should be made sure already in the planning phase that the monitoring equipment are suitable for dairy wastewater.

The pretreatment usually includes discharge balancing, grease separation, reduction of organic loading (biological processes) and neutralizing.

Examples of pre-treatment methods

Flotation

Even the light particles, which would normally settle down slowly or not at all (e.g. fibers from pulp and paper processing or grease from food processing), can be separated by flotation. In this process, liquid-solid separation is induced by dissolving pressurized gas into the treatment unit. The gas is released as micro-bubbles that rise to the surface, capturing the solids on the way. The sludge bed formed on the surface of the tank is withdrawn by scrapers or overflow, and must be subsequently processed. Chemical coagulant and/or flocculant are usually required to accumulate particles into separable flocs.

Fat and grease removal

Pretreatment is generally needed when industrial wastewater contain oils, fat or grease. Both animal-origin and plant origin fats block sewers and have high BOD concentrations. Fats need to be separated in grease traps, which need regular maintenance and overflow alarms.

Biological treatment

In addition to physical and chemical processes described above, biological processes may also be needed as pretreatment. Biological treatment is generally applied to reduce BOD loading to the WWTP, but it can also be designed to remove nitrogen. Biological pretreatment is suitable for industrial wastewaters with high concentrations of BOD and nitrogen.

Industrial wastewaters with high BOD concentration can also be pretreated with anaerobic processes. Anaerobic processes tend to have a lower energy demand and smaller sludge production compared to aerated processes.

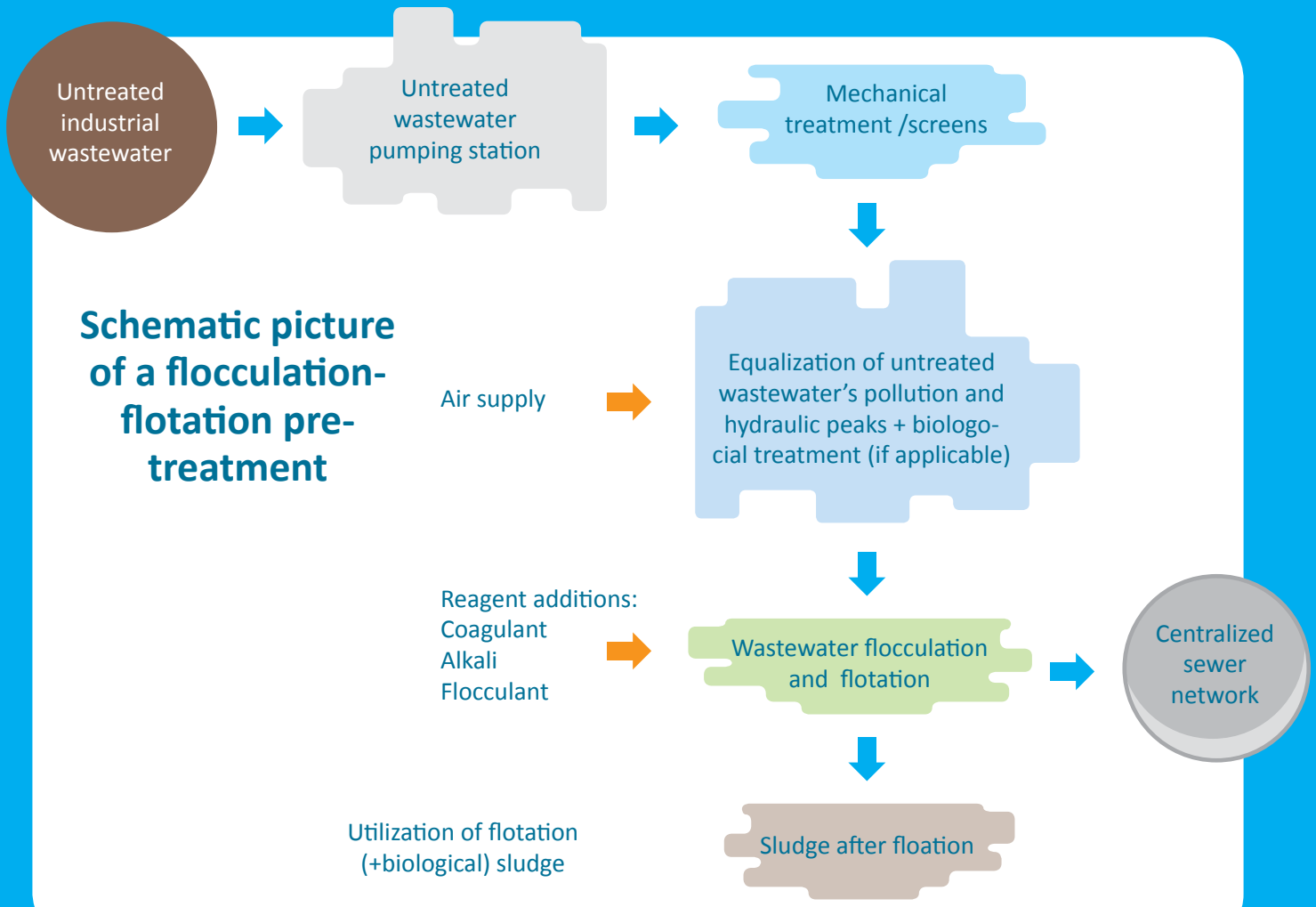
Neutralizing

Chemical treatment can be applied for neutralization, to improve solids removal. Chemical precipitation by coagulation and flocculation can be used also for removing phosphorus. Inorganic coagulants (typically ferric sulphate or polyaluminium chloride) and/or polymer are needed.

Balancing tank

The role of the balancing tank is to act as a buffer against the fluctuations in the wastewater volume or concentrations. In order to keep the volume and concentration even, the wastewater from an industrial plant is directed to a balancing tank before discharge to sewer.

Photo by Latvijas Piens ©.



In a nutshell: What should be taken into account when conveying wastewater from dairy industry to municipal sewer

- Capacity of the municipal wastewater treatment plant where the water is discharged
- Temperature and pH of the discharged wastewater
- Organic load of the discharged wastewater
- Fat and grease removal
- Content of suspended solids in the discharged wastewater
- Possible problems caused by hydrogen sulfide and odour in the network and at the wastewater treatment plant
- Corrosion risks caused to sewer network

Sources

Finnish Water Utilities Association, 2018. Finnish Industrial Wastewater Guide, Conveying non-domestic wastewater to sewers. Publication series no. 69 of the Finnish Water Utilities Association. Helsinki, 2018.

Afry 2020. Guidelines for Management of Industrial Wastewaters. Project BEST.

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