

# Adaptation measures for drainage, sewage and wastewater treatment in extreme weather events



## Climate change phenomena influencing drainage, sewer and waste water treatment



Increase of average temperature and decrease of precipitation – draughts. Higher temperature and draught has long-lasting influence and endangers first of all the environment.

The consequences for sanitation systems are:

- ✓ pollution load of waste water is higher through saving water strategies;
- ✓ decreasing dilution capacity of recipients requires stricter emission limits;
- ✓ it leads to the higher WWTPs purification requirements.



Long periods without precipitation followed by extreme strong flash rains - floods.

Heavy rainfalls have immediate effect endangering primarily people, structures and technologies by flooding. The consequences for sanitation systems are:

- ✓ drainage, sewer systems and WWTPs must be good protected against high peaks of hydraulic loads;
- ✓ retention reservoirs and storm water tanks should be prepared for additional storm water storage;
- ✓ possibility to treat first flash storm water with high concentration of pollutants is necessary.

# Impact of the dry period on the sanitation system



## **Prolonged period without any rainfall lead to lower waste water emissions, low water flow through the conduits and consequently to:**

- ☹ accumulation of solid waste sediments and incrustation in sewerage conduits that can cause its clogging;
- ☹ water rotting in the system attended by unpleasant odour;
- ☹ increasing population of rodents associated by increased quantities of sediments and solid waste in pipelines;
- ☹ growing risk in disease dissemination;
- ☹ salt water intrusion especially in coastal agricultural areas causing degradation of sewer conduits and affecting the quality of waste water.

## Increasing air temperature affects processes of UWWT:

### Negatives

- ☹️ lower oxygen solubility in water can cause possible lower efficiency of active sludge compartment, which leads to higher consumption of compressed air in biological treatment;
- ☹️ higher dust concentration causes higher costs of air filtration;

### Positives

- 😊 due to higher temperature the biological process can be faster;
- 😊 sludge dewatering is faster;
- 😊 cost for heating of anaerobic digesting facilities is lower.

## Adaptation measures on urban sanitation systems in the case of draught

### Keep the equipment clean:

- 🔔 periodically clean pipelines (by service water) to prevent their choking by the suspended solids;
- 🔔 periodically control and clean of electromechanical UWWTP equipment;
- 🔔 regularly rinse adjacent pavements and roads ( by hygienic safe water).

### Use of mathematical models:

- 🔔 carry out measurement and monitoring for calibration of the models;
- 🔔 illustrate the flow through the system;
- 🔔 identify most critical points.

### Other preventive measures:

- 🔔 develop the Maintenance and emergency plan, preferably in cooperation with other involved institutions and companies (roads management, municipal authorities, etc.);
- 🔔 train the staff for the emergency situation.



### Operation:

- 🔔 the UWWTP must be constructed to be able to maintain high efficiency in the case of increased pollution loads;
- 🔔 adapt the amount of the dissolved oxygen in the activation tanks to the higher demand during extreme pollution load (if possible by means of automatic regulation of the process).



## Impact of the storms and heavy rains on the sanitation system



## Basic precondition for design of heavy rain adaptation measures is the knowledge of:

-  weather change indicators and provision of information on current weather conditions – reliable forecast;
-  potential vulnerability of the sanitation system related to the changes in hydrological conditions in the respective area, type of sewer system (combined, separate), type of technological process in UWWTP (biological, physico-chemical, etc.) and type of the drained area (centralised, decentralised).

## The measures can be divided into two categories:

-  preventive measures - undertaken before any emergency situation occurs;
-  protective measures – in the case of the emergency situation.



# Preventive measures against floods

## Strategic measures

- ⌚ Regularly updated crisis and emergency plans based on co-operation of all actors (facilities owners, operators, municipal authorities, river basin authorities, flood authorities, flood forecasting authorities, stakeholders).
- ⌚ Regular training of the staff, which should be capable to recognise the danger and respond it.
- ⌚ Detailed mapping of the system should be available, preferably in the GIS form.
- ⌚ Where possible simulation models of storm water run off based on precise measurement and calibration should be developed.
- ⌚ The emergency system should be regularly tested.

# Preventive measures against floods

## Technical measures

- ⌚ Construction of separate drainage for rain water where possible.
- ⌚ Construction of protective measures against flood (permanent, mobile).
- ⌚ Installation of retention tanks for superfluous flash water (especially in the case of combined sewers).
- ⌚ Periodical preventive maintenance of the system and its important nodes, precise cleaning and washing of pipelines and tanks.
- ⌚ Keeping pipelines waterproof and impermeable to prevent infiltration of waste water to groundwater as well as the flood water from outside to sewers.
- ⌚ Performing of regular maintenance of machines and electric parts of pumping stations.
- ⌚ Having spare flood pumps available for emergency situation.
- ⌚ Having alternative electricity sources prepared as power failure occurs often during flood.

# Protective measures during flood

## General principles

- 🔦 The system should be kept in operation as long as possible.
- 🔦 Good communication between UWWTP operators and river basin authorities, dam operators, flood protection bodies, forecasting institutes, and other involved institutions is inevitable.
- 🔦 The use of simulating models for defining appropriate measures and real time control system is advisable.
- 🔦 For large systems the central operational unit should be in charge to steer and supervise response of the network.

## Technical measures

- 🔦 Immediately install the flood mitigation and protective technical components (flood protective walls, pumping devices etc.).
- 🔦 Location of essential compartments above the flood level or in tanks is an advantage.
- 🔦 Close anti backflow devices and use pumps to protect system against back wave from recipient.
- 🔦 All the time keep maximum hydraulic capacity of the system, preventing solids sedimentation.
- 🔦 Bring electric generators to the stand-by position and use them when necessary.
- 🔦 If needed remove all endangered dismountable equipment to prevent its damage.
- 🔦 Store all chemical staffs and other contaminants on the safe place.

## Protective measures during flood in rural areas

- 💣 Most of previous advises are valid also for small UWWTPs rural areas.

Owners of small private houses have to:

- 💣 avoid release of the contaminated sludge from septics and cesspools to the water;
- 💣 protect the sources of drinking water (wells) from contamination;
- 💣 after the flood remove all sludge from cesspools and septics to transport it to treatment on the nearest UWWTP.



# Recovery of the sanitation system after the flood



## Recovery of sanitation system after the flood

### General measures

- ✦ restart the operation of the system as quickly as possible;
- ✦ verify, restore and monitor passability of the conduits and pumping stations;
- ✦ clean and disinfect affected UWWTP area, including buildings and technological equipment;
- ✦ assess the stability of buildings and structural compartments;
- ✦ draw up the plan of recovery on the basis of thorough damage analysis.

### Technical measures (keep the order)

- ① ensure electric energy supply;
- ② make waste water distribution and bypass systems passable;
- ③ start the pre-treatment (bar screen, grease trap), with bypass of sedimentation and biological treatment;
- ④ start sludge management operation (at least sludge storage reservoirs), which is the precondition for start of primary sedimentation;
- ⑤ start the operation of mechanical treatment and possible chemical precipitation in primary sedimentation tanks (precondition is functioning pre-treatment and sufficient capacity for sludge storage);
- ⑥ start the operation of aeration system and gradual put the biological stage into operation (precondition is functioning of primary sedimentation);
- ⑦ gradually put the automatic management system into operation.

## Biological stage put into the operation – sludge recovery

- ★ Inoculation with sludge from other UWWTP;
- ★ cultivating of the new sludge;
- ★ use of the original sludge preserved, even if decayed after aeration switch off.

Putting the biological stage into operation comparable with the original one takes several months regardless the way chosen.



# Specific issues of industrial waste water treatment plants





## Preventive and protective measures for industrial plants

- ⚠ Basic principles applied by UWWTPs are valid.
- ⚠ Flood protection measures must reflect the fact that each industrial plant use different techniques, technologies as well as raw material.
- ⚠ Each facility should have its own crisis and emergency plan, including the emergency warning system, detailed analysis of used technologies, equipment and chemicals and basic principles of recovery.
- ⚠ Regulations valid for hazardous substances have to be respected – safe intermediate storage of contaminated water, sludge and other chemicals should be used enabling their consequent safe disposal;
- ⚠ The emergency situation can affect not only water and its environment, but also other components of environment;
- ⚠ Special training of staff covering all possibilities is inevitable.

## Recovery measures in industrial plants

- ✦ Make the site accessible;
- ✦ assess the damage and develop detailed recovery plan;
- ✦ re-establish the sources of electric power;
- ✦ clean sewer conduits;
- ✦ perform stepwise recovery of the whole treatment process (from preliminary treatment to automatic control).

# Thank you for your attention



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