Centralised wastewater treatment systems in cold climates

Harsha Ratnaweera
Faculty of Science and Technology
Norwegian University of Life Sciences (NMBU)
harsha.ratnaweera@nmbu.no
The collection and treatment of waste water in all agglomerations of > 2´000 p.e.

Secondary treatment of all discharged from agglomerations of > 2´000 p.e., and more advanced treatment for agglomerations > 10´000 population equivalents in designated sensitive areas and their catchments.
Type of treatment: Status in 2017
Treatment efficiency N&P

Status in 2017

Estimated treatment efficiency for phosphorus and nitrogen. Counties. 2001. Per cent

Status in 2001

Kilde: Almnn. Miljødirektoratet
Why most WWTPs in Norway are covered
Why most WWTPs in Norway are covered
Average Temperature

Dec – Jan – Feb

Atlas of the Biosphere
A paradox?

Air temperature \(\uparrow\)

Wastewater temperature \(\downarrow\)
A paradox?

- Air temperature \(\uparrow\)
- Wastewater temperature \(\downarrow\)
- Increased snow melting events
- Combined sewers
Separate sewers vs combined sewers

Good separate system vs Combined system or system with much external intrusion water
Chemical-Biological treatment. Simultaneous precipitation

Chemical-Biological treatment. Pre-precipitation

Chemical-Biological treatment. Post-precipitation
How may the challenges of varying temperatures – especially in connection with snow-melt, be solved?

Use separate systems – do not mix wastewater with rainwater.

Select processes that can stand better variations in temperature.
Impact of temperature on coagulation

Floc formation during wastewater coagulation is known to be slower at lower temperatures.

Sedimentation / flotation can therefore be negatively influenced.

- ↑ sedimentation volumes
- ↑ coagulant/flocculent demand
Temperature impact on floc building

Floc building slows down at lower temperatures

5 °C - smaller flocs

20 °C - larger flocs
Cold climate:

↓ Efficiency

↑ Cost

↓ 10 degrees = ↓ of 50% of Nitrification rate

will require bigger reactor volumes to achieve the same treatment efficiencies

Enzyme producing bacteria
Climate change results in challenges with the volumes and WW temperatures.

The main challenge with WWT in cold climates is not the low temperature as such, but the large variation in temperature.

The Norwegian experiences with pre-treatment by the use of fine-mesh sieves in cold climates are good.

Chemical coagulation has several advantages over biological processes for secondary treatment in cold climates.

Combined biological/chemical treatment by the use of MBBR directly followed by coagulation/separation is extensively used and preferred in Norwegian cold climate plants.

If nitrogen removal is required, combined pre- and post-denitrification based on MBBR and coagulation is preferred.