Water Rennovation in Ukraine
Project no. 22320101

Water Rennovation in Ukraine

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The project is co-financed by the Governments of the Czechia, Hungary, Poland and Slovakia through Visegrad Grants from International Visegrad Fund. The mission of the fund is to advance ideas for sustainable regional cooperation in Central Europe.

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WWTP for the urban areas

Lubos Jurik

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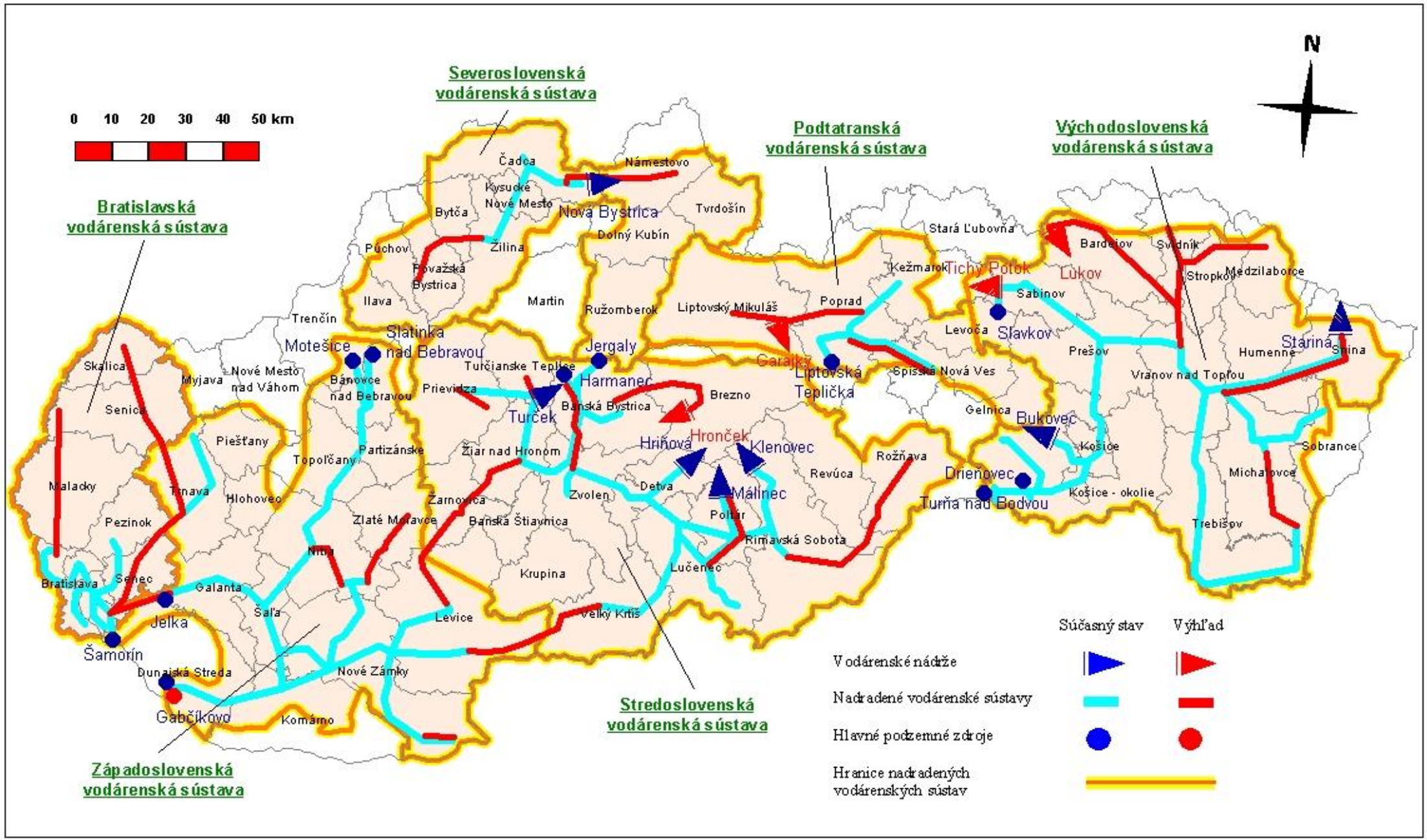
NADRADENÉ VODÁRENSKÉ SÚSTAVY

Mapka č. 4



Composition of Wastewater

- **Inorganics**
  - Ammonia
  - Nitrate
  - Phosphate
  - Carbonate
  - Minerals
    - Calcium
    - Magnesium
    - Iron
    - Etc.

- **Organics**
  - Biodegradable (BOD)
    - Carbohydrates
    - Proteins (TKN)
    - FOG
  - Non-Biodegradable (COD-BOD)
    - Large particles
    - Complex polymers (plastics, lignin)
    - Surfactants (some)
    - Pesticides (some)
    - Pharmaceuticals (some)

Bacteria

- $C_5H_7O_2N$
- Growth rates double every 10ºC until optimum temp reached
- pH optimum 6.5-7.5
- Nutrients may be limited in industrial wastewaters

Constituent or element	Percent of dry weight
Major cellular material	
Protein	55.0
Polysaccharide	5.0
Lipid	9.1
DNA	3.1
RNA	20.5
Other (sugars, amino acids)	6.3
Inorganic ions	1.0
As cell elements	
Carbon	50.0
Oxygen	22.0
Nitrogen	12.0
Hydrogen	9.0
Phosphorus	2.0
Sulfur	1.0
Potassium	1.0
Sodium	1.0
Calcium	0.5
Magnesium	0.5
Chlorine	0.5
Iron	0.2
Other trace elements	0.3

Theoretical Yield
[(g cell / g glucose) / (g COD O2 / g glucose)]

- Solve for the theoretical yield

$$\underset{3(180)}{3C_6H_{12}O_6} + \underset{8(32)}{8O_2} + \underset{2(17)}{2NH_3} \rightarrow \underset{2(113)}{2C_5H_7NO_2} + 8CO_2 + 14H_2O$$

$$\text{COD} = \frac{\Delta(O_2)}{\Delta(C_6H_{12}O_6)} = \frac{6(32\ \text{g/mole})}{(180\ \text{g/mole})} = 1.07\ \text{g}\ O_2/\text{g glucose}$$

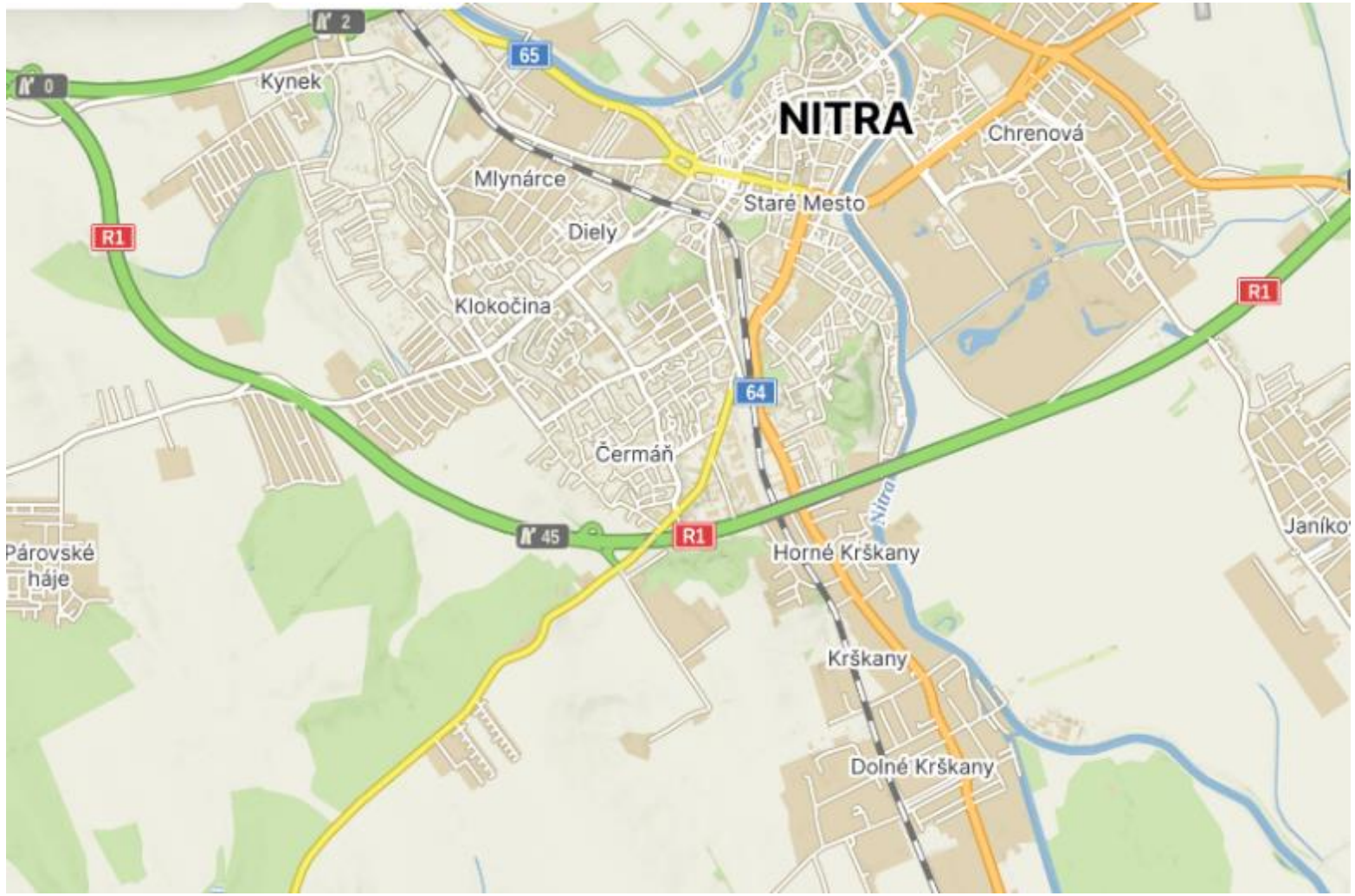
$$Y = \frac{\Delta(C_5H_7NO_2)}{\Delta(C_6H_{12}O_6\ \text{as COD})} = \frac{2(113\ \text{g/mole})}{3(180\ \text{g/mole})(1.07\ \text{g COD/g glucose})}$$

$$= 0.39\ \text{g cells/g COD used}$$

WWTP Nitra

Visegrad Fund

WWTP Nitra location



WWTP Nitra

Visegrad Fund

Project ISPA: 2000/SK/16/P/PE/002

Financing:

ISPA/kohézny fond/	**50%**	**5 177 100**	**EUR**
Slovakia	**25%**	**2 588 550**	**EUR**
Nitra Town	**25%**	**2 588 550**	**EUR**
Total:		**10 354 200**	**EUR**

Investment : Mesto Nitra

Technical advisor: Carl Bro Group,Denmark

Costruction : Conzortium VÁHOSTAV-KPRIA- INGSTAV

Buiding parts: Váhostav – SK, a.s. Žilina

Technologie: Královopolská a.s, Ingstav a.s.

User: Town Nitra and Západoslov. vodárenská spoločnosť, a.s. Nitra

WWTP Nitra location

Visegrad Fund

WWTP Nitra

Finished: 18.10.2007

WWTP Nitra Krškany is placed at left bank of Nitry river.
Capacity of WWTP is 212 000 EI.
Yearly outflow is 13 249 500 m³

WWTP Nitra

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The Wastewater Treatment Process

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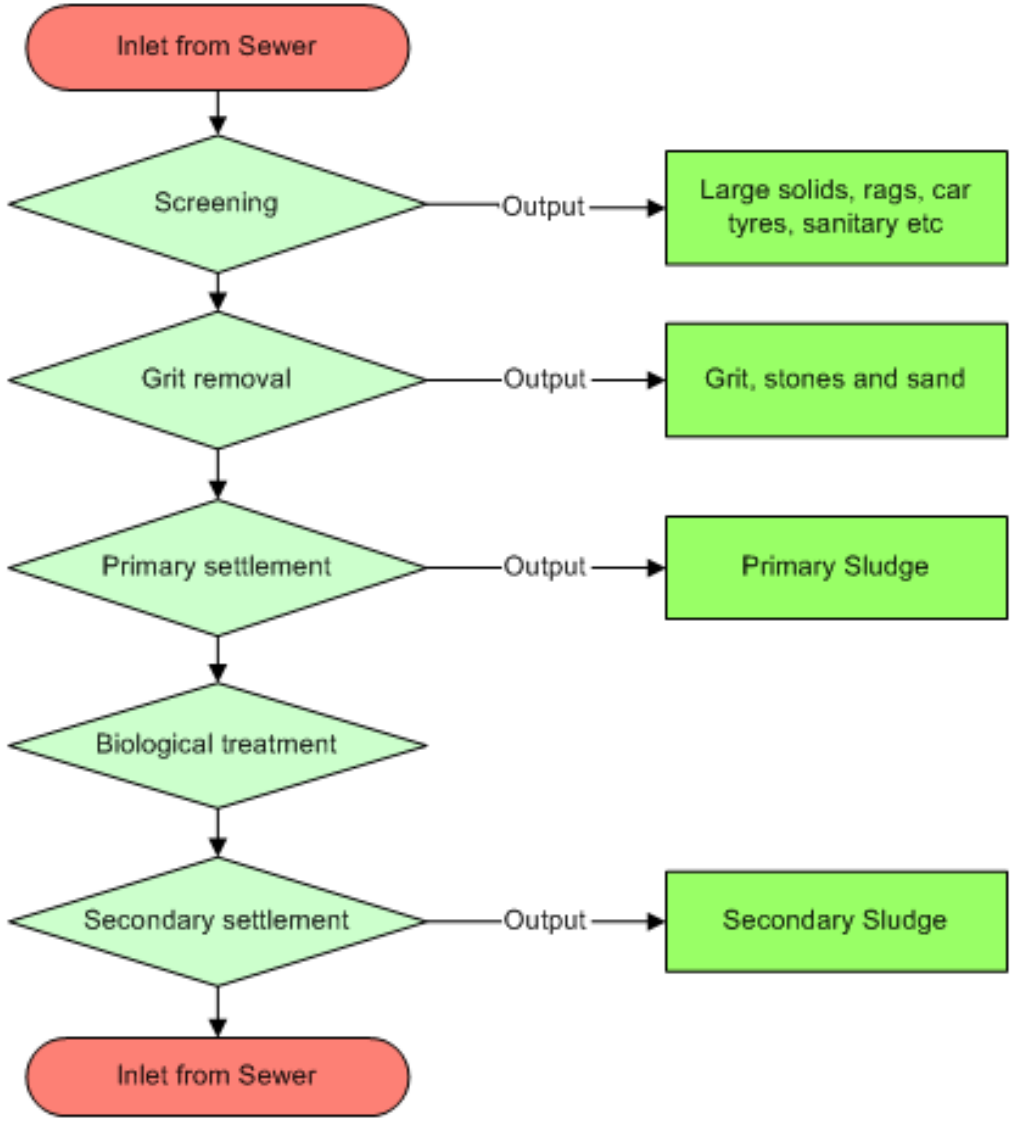
Preliminary Treatment

Primary Treatment

Secondary Treatment

Tertialy treatnent



Inflow part

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Inflow from the municipality

Flow measurement at the inflow

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Gravel trap at the inflow before pumping

Coarse screens

Captured grabs at screens

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Mechanical pretreatment

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Pumping station Archchimedes screew

Pumping station Archchimedes screew

Outflow from fine screens

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Sand trap and fats and oils captures

Sand trap

Visegrad Fund

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Primary settlement and Sludge regeneration

Primary setlement

Visegrad Fund

Primary setlement

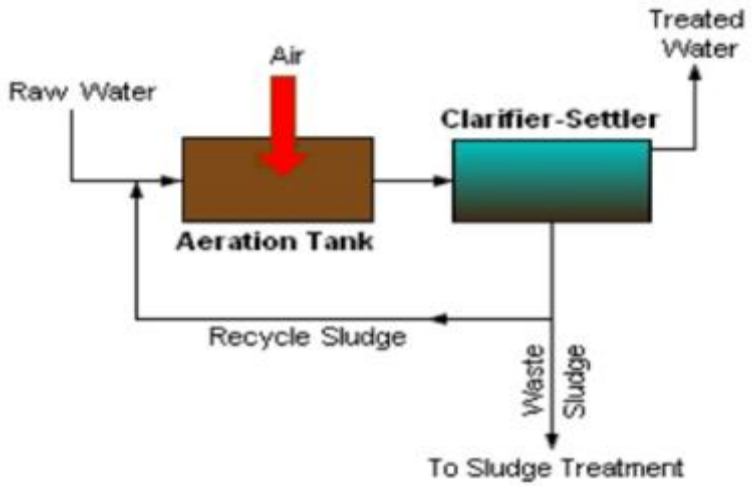
Primary setlement

Outflow from primary settlement to biological treatment

Visegrad Fund

Activated Sludge (ASP)

Activated sludge consists of a mass of micro-organisms which feed on pollutants in the sewage. The bacteria is suspended in liquid and is called “mixed liquor”, it is mixed with sewage and aerated in aeration basins before passing to final settlement tanks where it is settled and the sludge returned. The effluent produced is of a high quality.



Biological treatment

Visegrad Fund

Biological Treatment

Visegrad Fund

Activated Sludge technology - construction

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Air blowers BOD5

Nitrification

- NH_4^+ → *Nitrosomonas* → NO_2^-
- NO_2^- → *Nitrobacter* → NO_3^-
- Notes:
  - Aerobic process
  - Control by SRT (4 + days)
  - Uses oxygen → 1 mg of NH_4^+ uses 4.6 mg O_2
  - Depletes alkalinity → 1 mg NH_4^+ consumes 7.14 mg alkalinity
  - Low oxygen and temperature = difficult to operate

Denitrification

- Using methanol as carbon source:

  $6\ NO_3^- + 5\ CH_3OH \rightarrow N_2 + 5\ CO_2 + 7\ H_2O + 6\ OH^-$

- Using an endogenous carbon source:

  $C_5H_7NO_2 + 4.6\ NO_3^- \rightarrow 2.8\ N_2 + 5\ CO_2 + 1.2\ H_2O + 4.6\ OH^-$

Finaly settlement

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Finaly setlement

- Visegrad Fund

WWTP finaly setlement

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Sludge regeneration

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Sludge treatment

Visegrad Fund

Sludge treatment

Visegrad Fund

WHAT IS SLUDGE?

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Bacteria and other micro-organisms

Mainly water (up to 99%)
Dissolved solids
Settled and suspended solids
- Faecal matter
- Nutrients (N, P, K)
- Metals
- Energy

Sewage sludge

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WWTP Nitra Sluge stabilisation and Biogas

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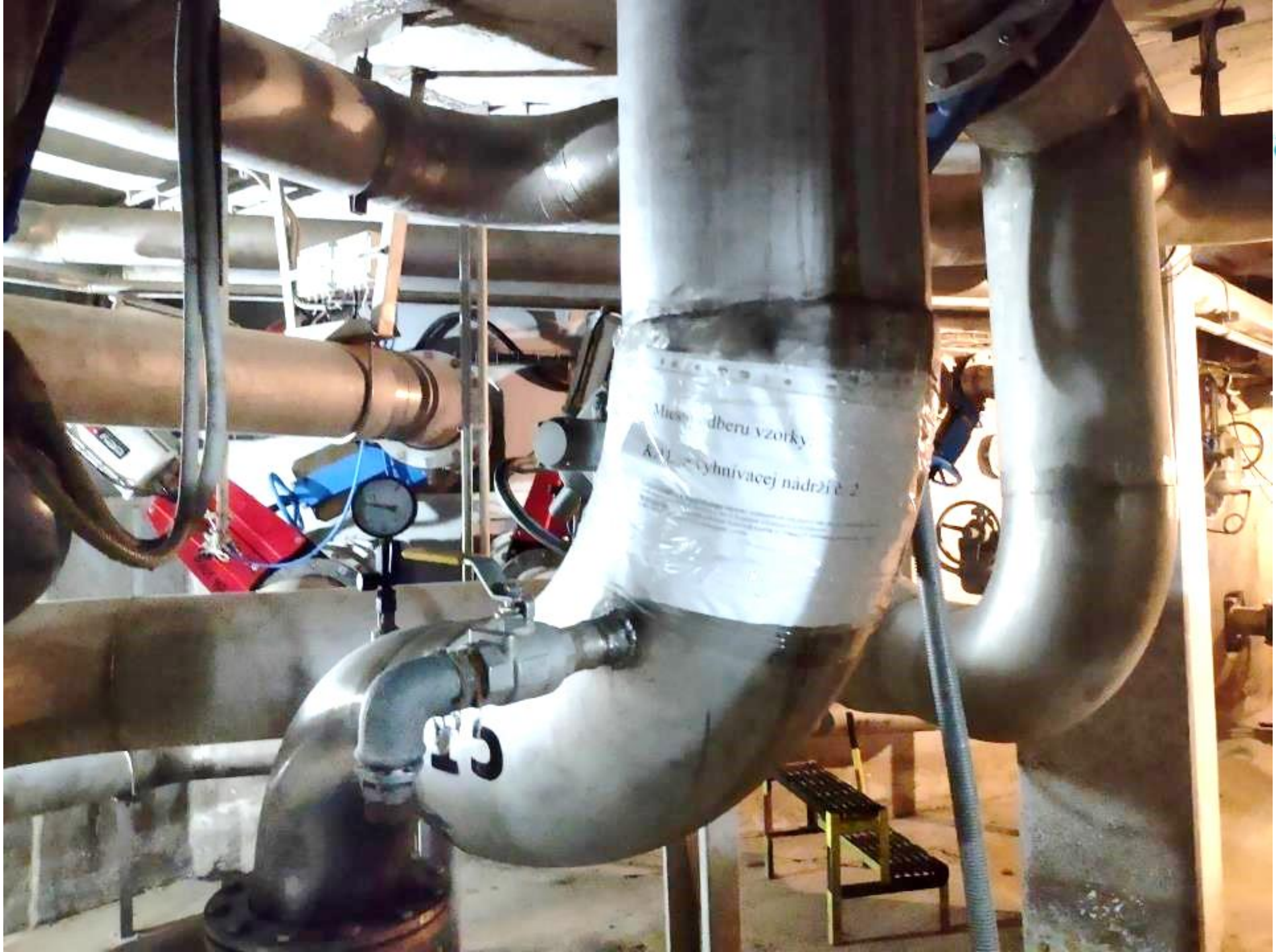

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Sludge stabilisation

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Biogas storage space

Incineration of surplus gas

Visegrad Fund

Outflow to the river

Visegrad Fund