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Drawbacks & Opportunities of Electrocoagulation Technology in the Wastewater Treatment

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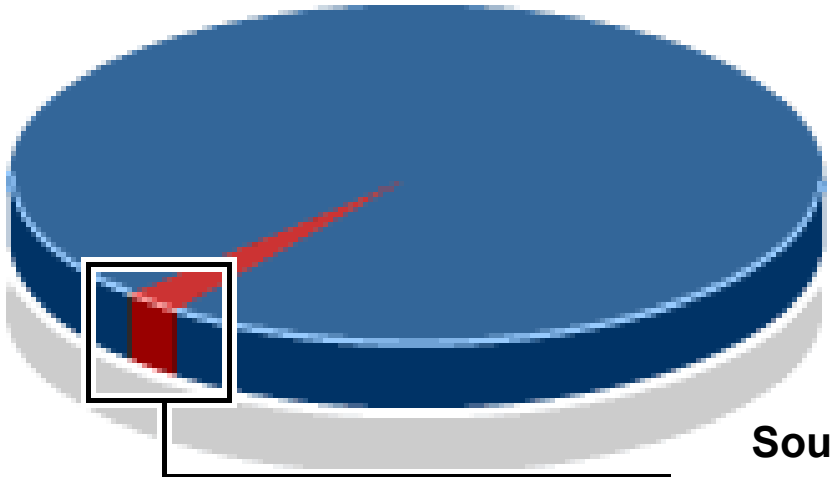
World Water Supply

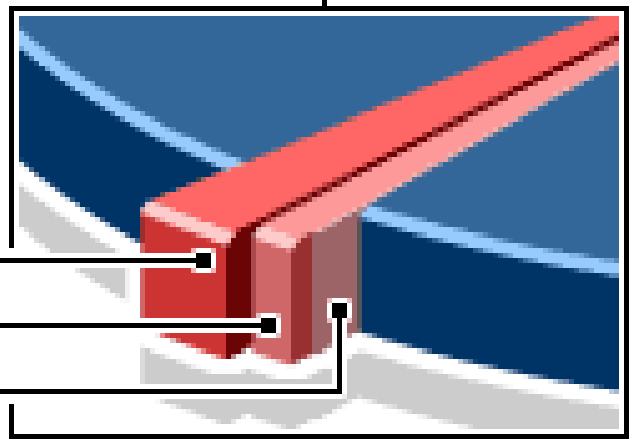
Saltwater
97.5%

Freshwater
2.5%



Source: WHO

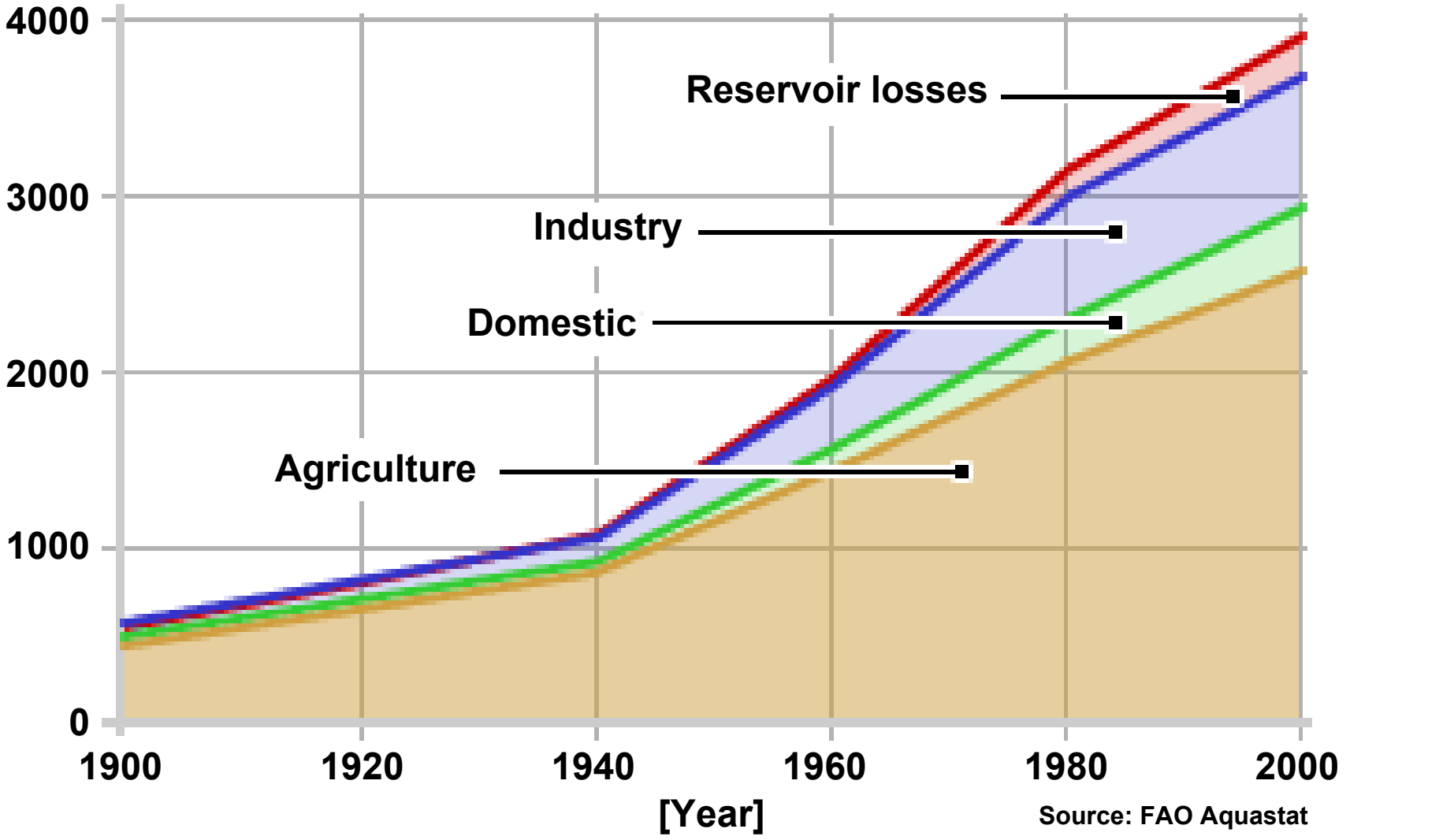
Total available for anthropogenic consumption is less than **0.007%**



68.9% – Glaciers
30.8% – Groundwater
0.3% – Lakes and Rivers

World Water Use

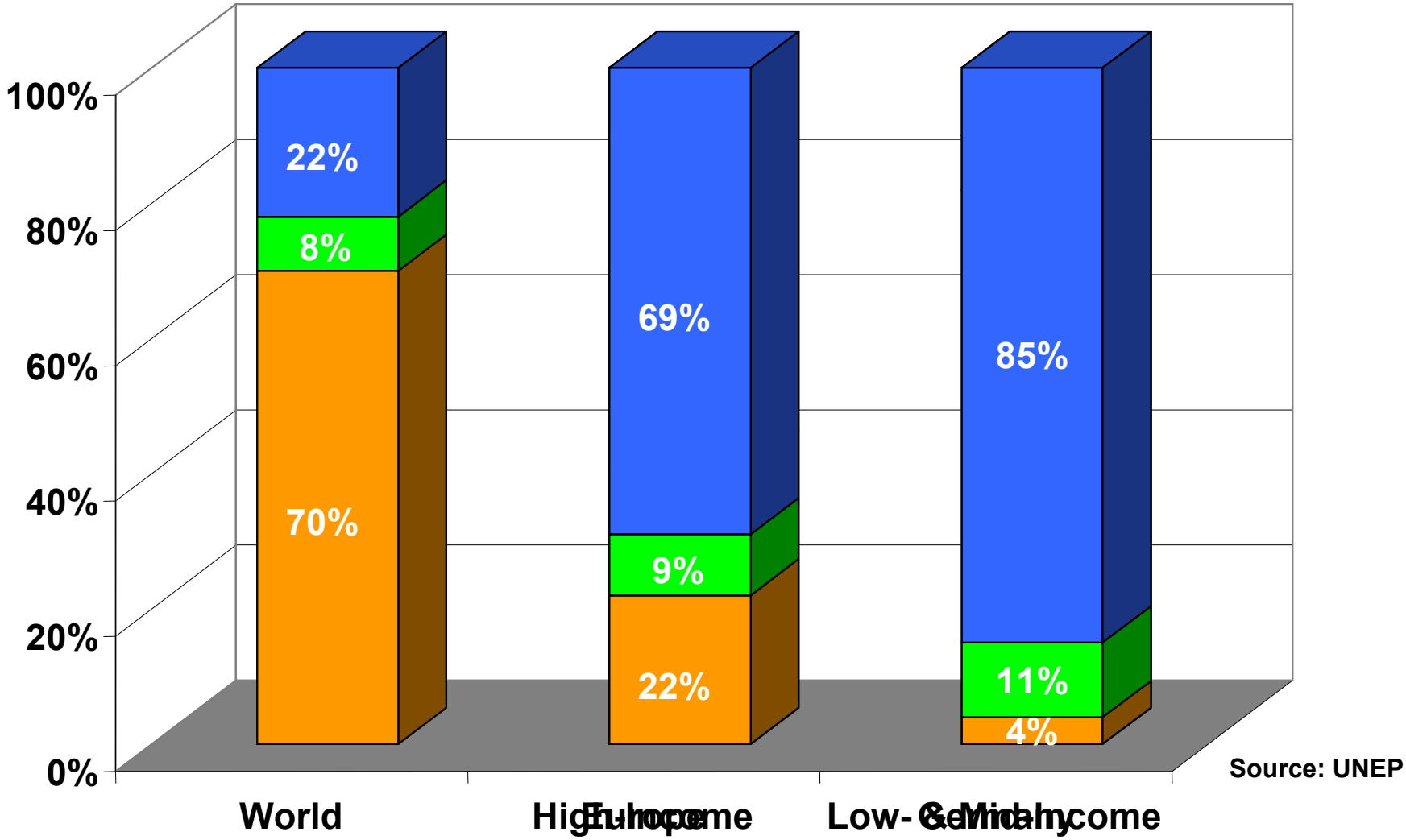
In **2020**, **17%** more water than is available will be required to feed the world



Source: FAO Aquastat

Competing Water Uses

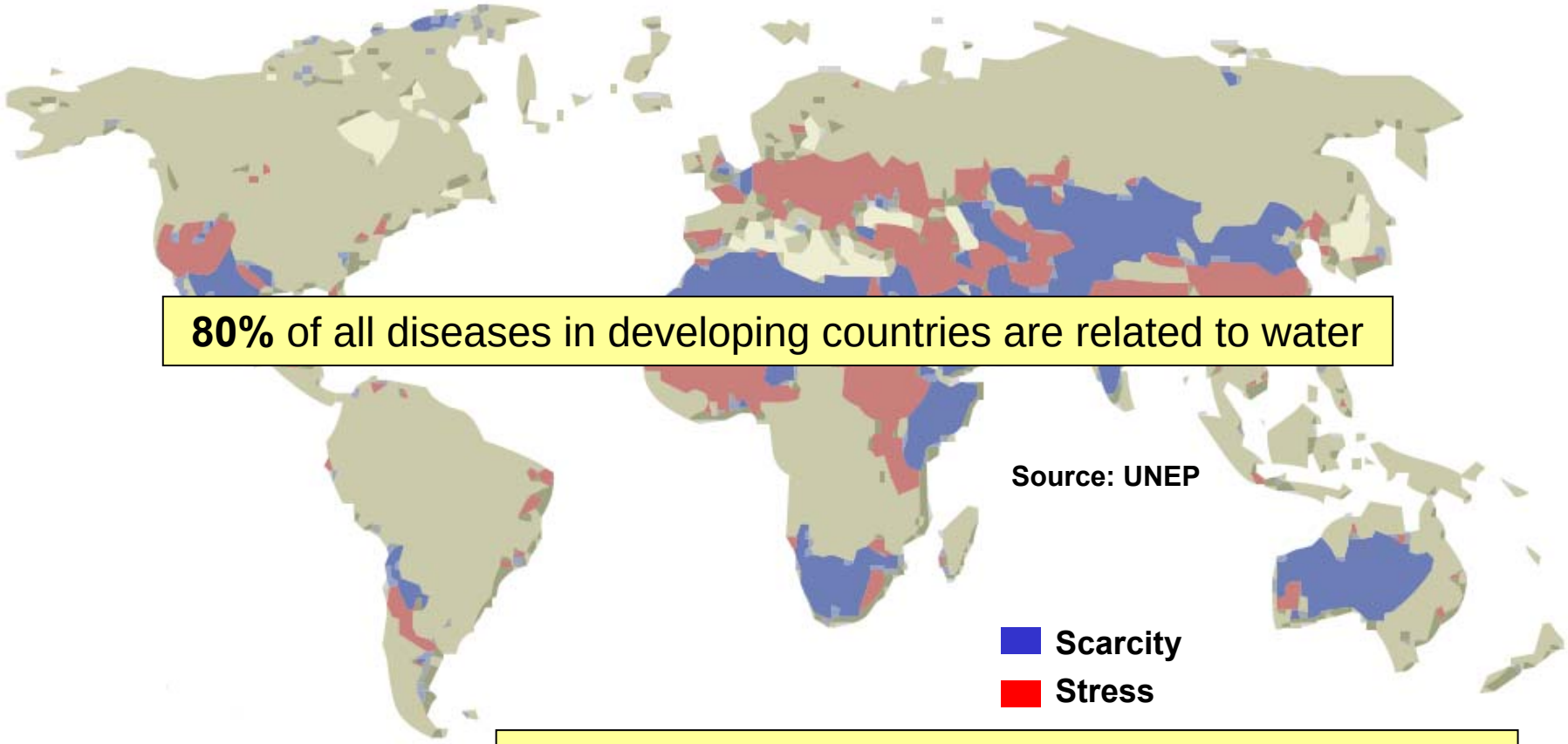
A compromise concerning **Sustainable Water Reuse Practices** must be found



Source: UNEP

Predicted World Water Scarcity & Stress in 2025

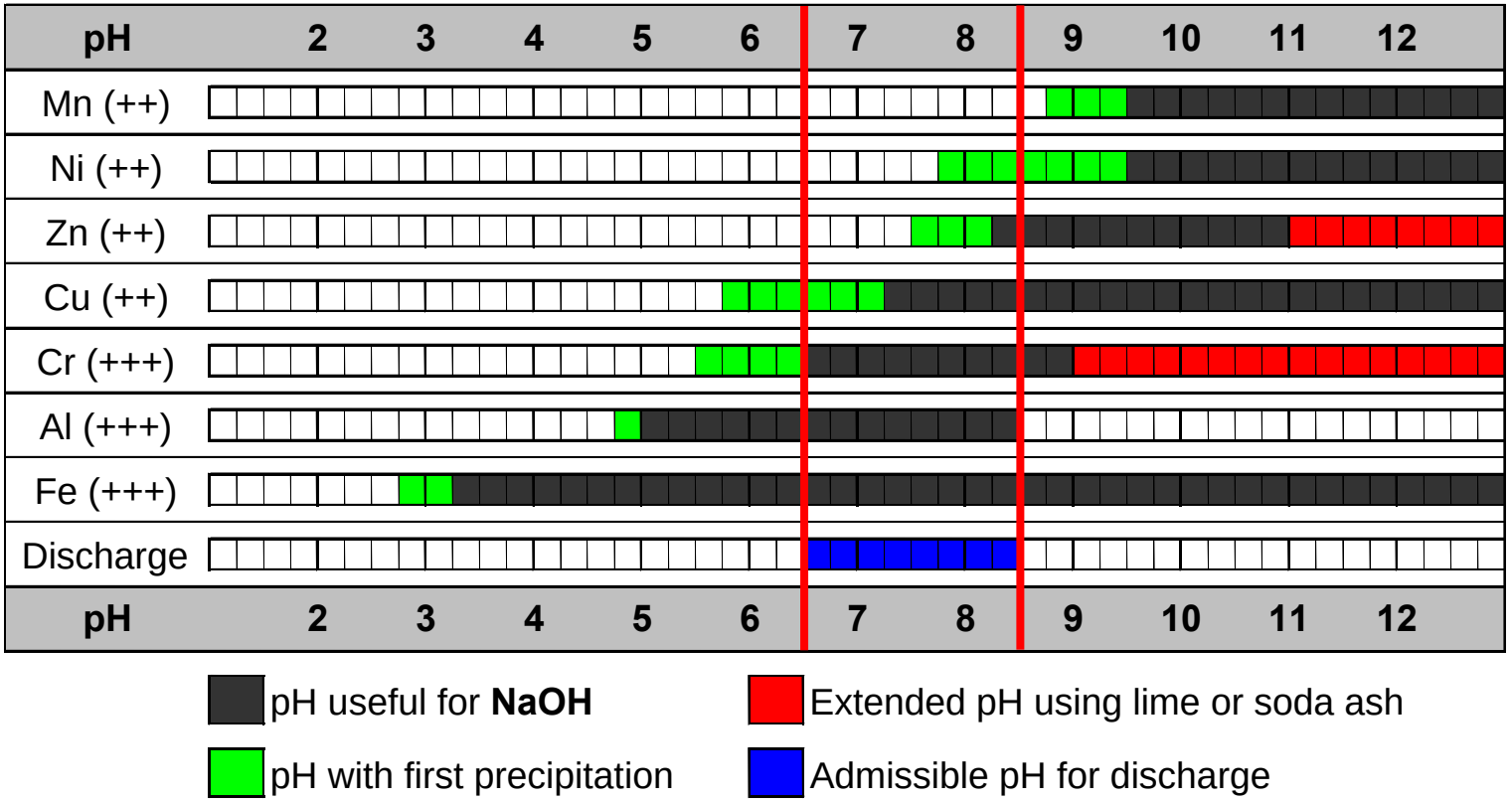
50% of world's population do not have access to adequate sanitation **(2.64 B.)**
20% do not have sustainable access to safe drinking water **(1.0 B.)**



80% of all diseases in developing countries are related to water

Water-borne diseases kill more than **25,000 people** on a daily basis, from them a child every **8 seconds**

Lack of Efficiency in Industrial Wastewater Treatment



Some heavy metals like **Manganese (Mn),** force the precipitation process to go over the neutral range in order to achieve their removal

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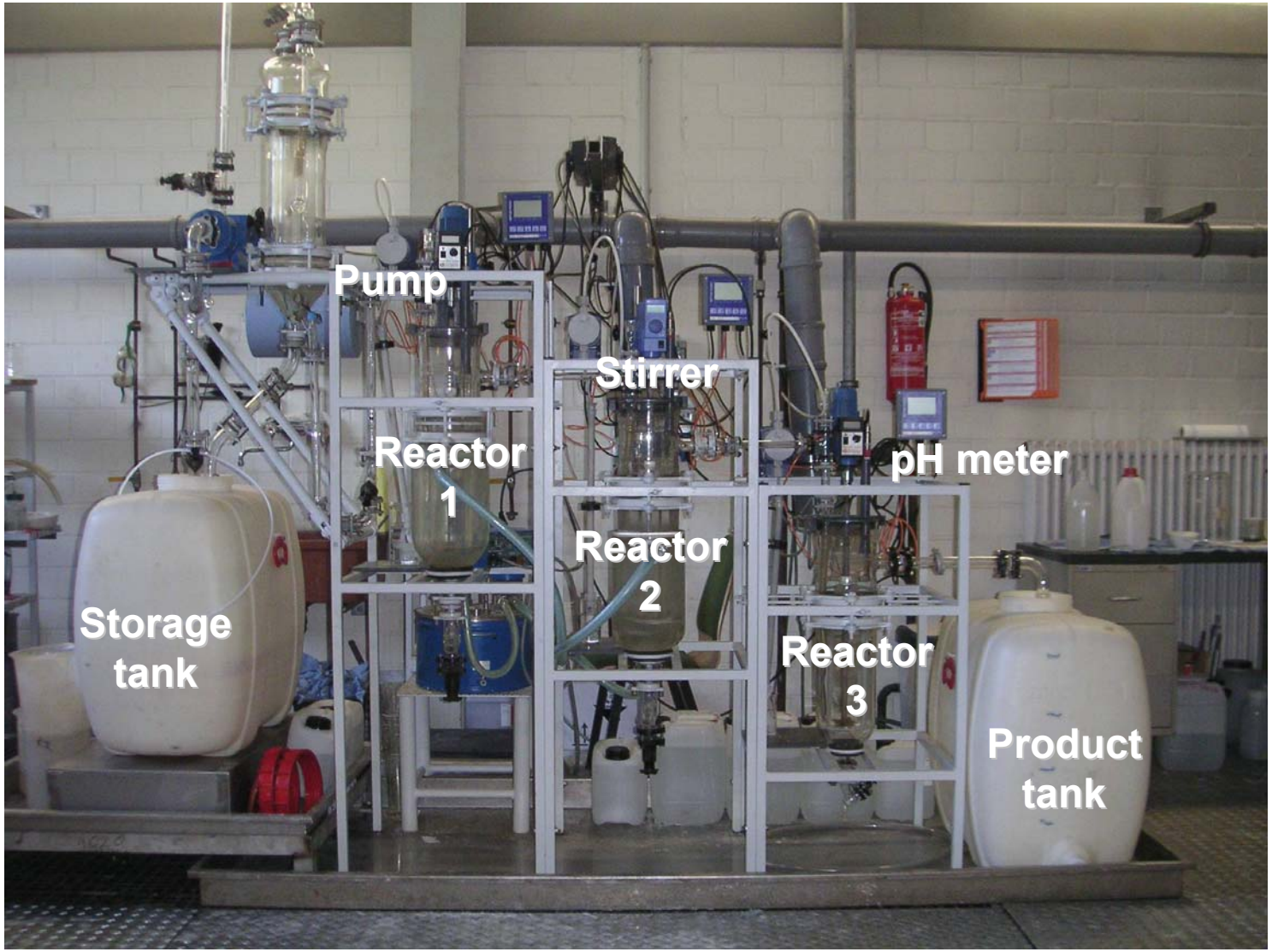
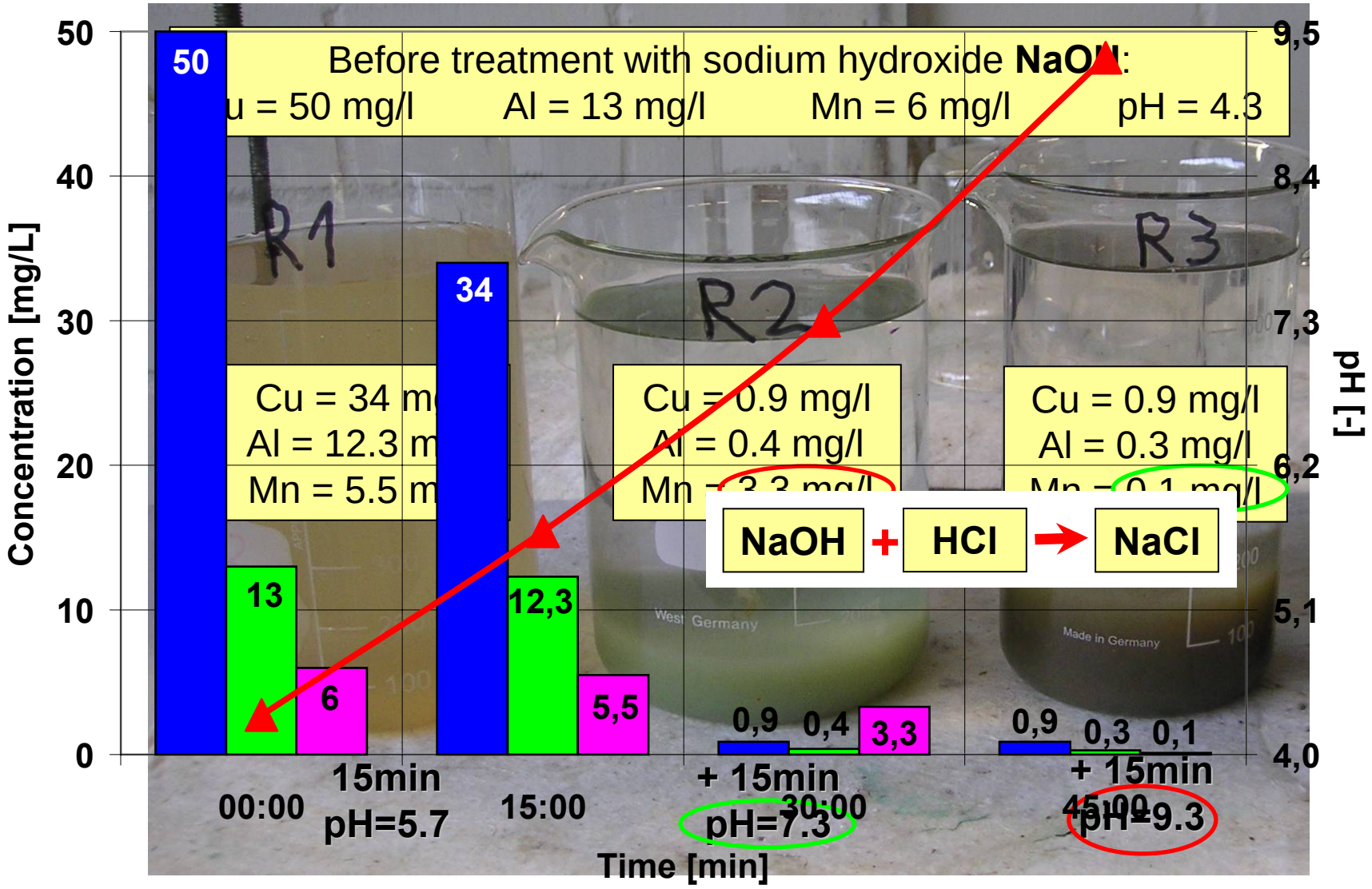
Wastewater Treatment using a Precipitation Line



Hydroxide Precipitation of Copper Production Effluents



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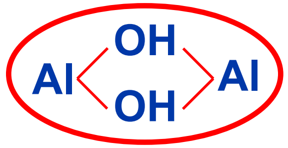
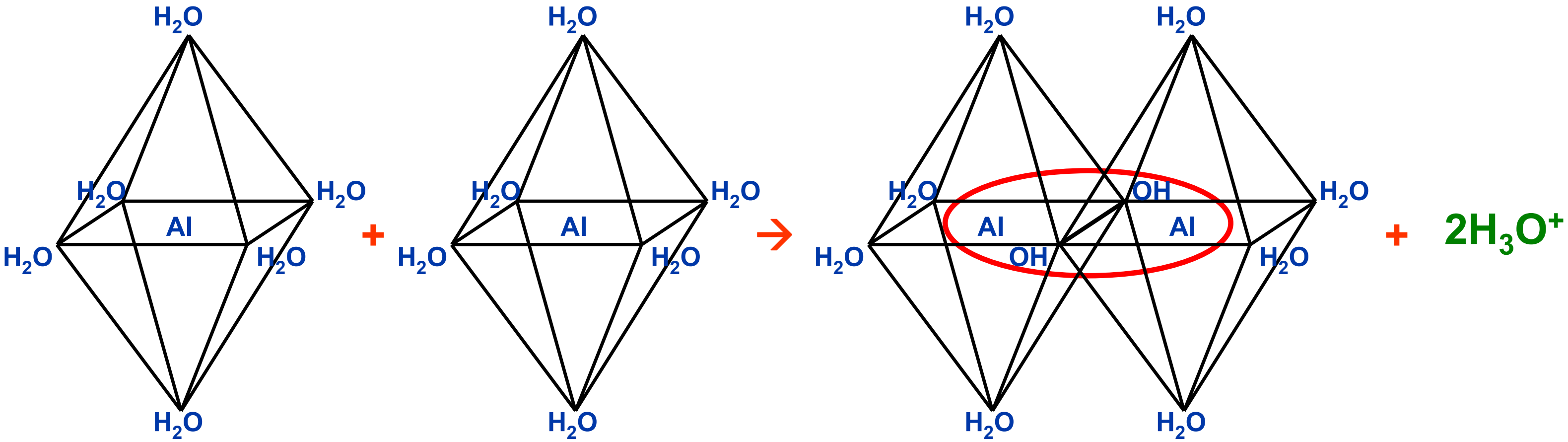
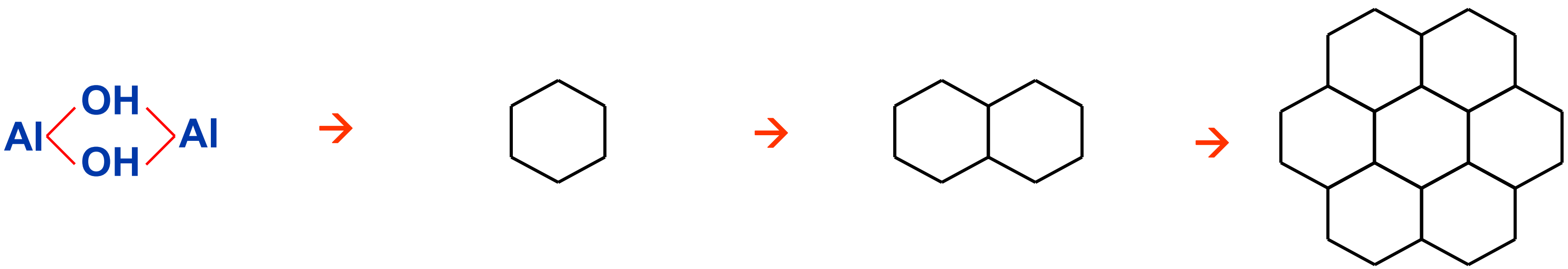
Proposed Electrocoagulation Mechanism

$2\ Al(H_2O)_6^{3+} \rightarrow Al_2(OH)_2(H_2O)_8^{4+} + 2H_3O^+ = 8\ H_2O +$  $+ 2H_3O^+$

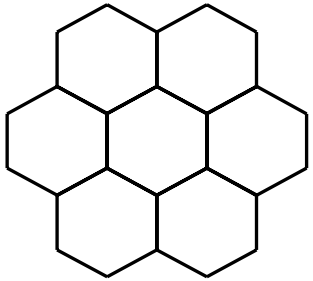


Hydrolysis, Condensation & Complexation

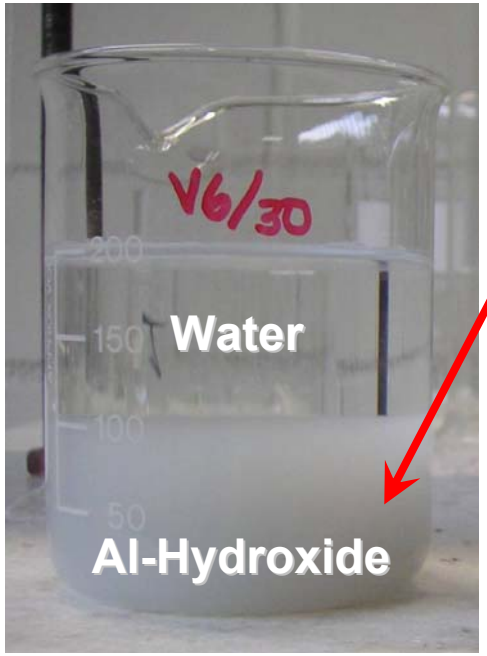


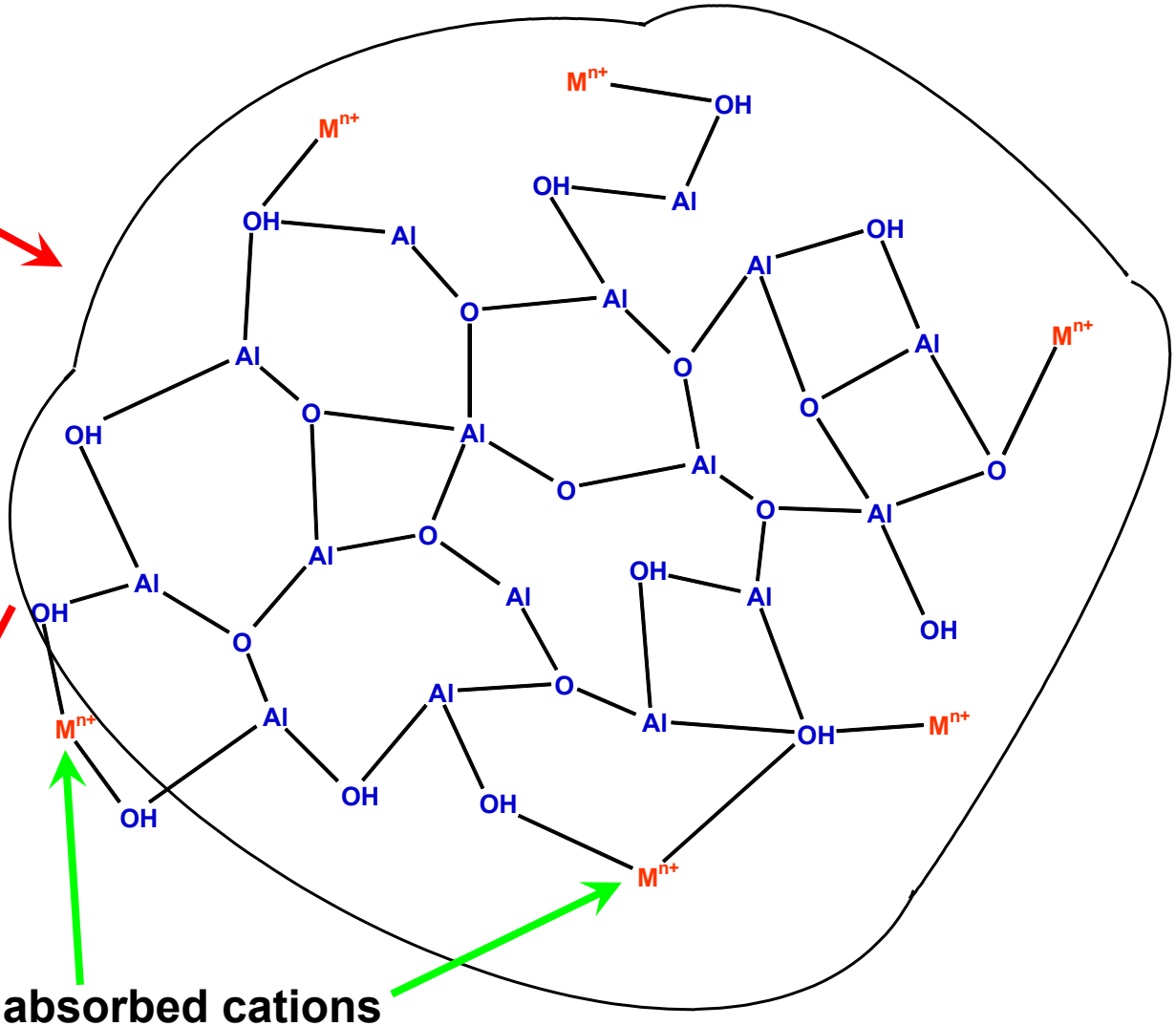
$Al_2(OH)_2(H_2O)_8^{4+} \rightarrow Al_6(OH)_{12}(H_2O)_{12}^{6+} \rightarrow Al_{10}(OH)_{22}(H_2O)_{16}^{8+} \rightarrow Al_{24}(OH)_{60}(H_2O)_{24}^{12+}$

Absorption Principle of Aluminium Hydroxide

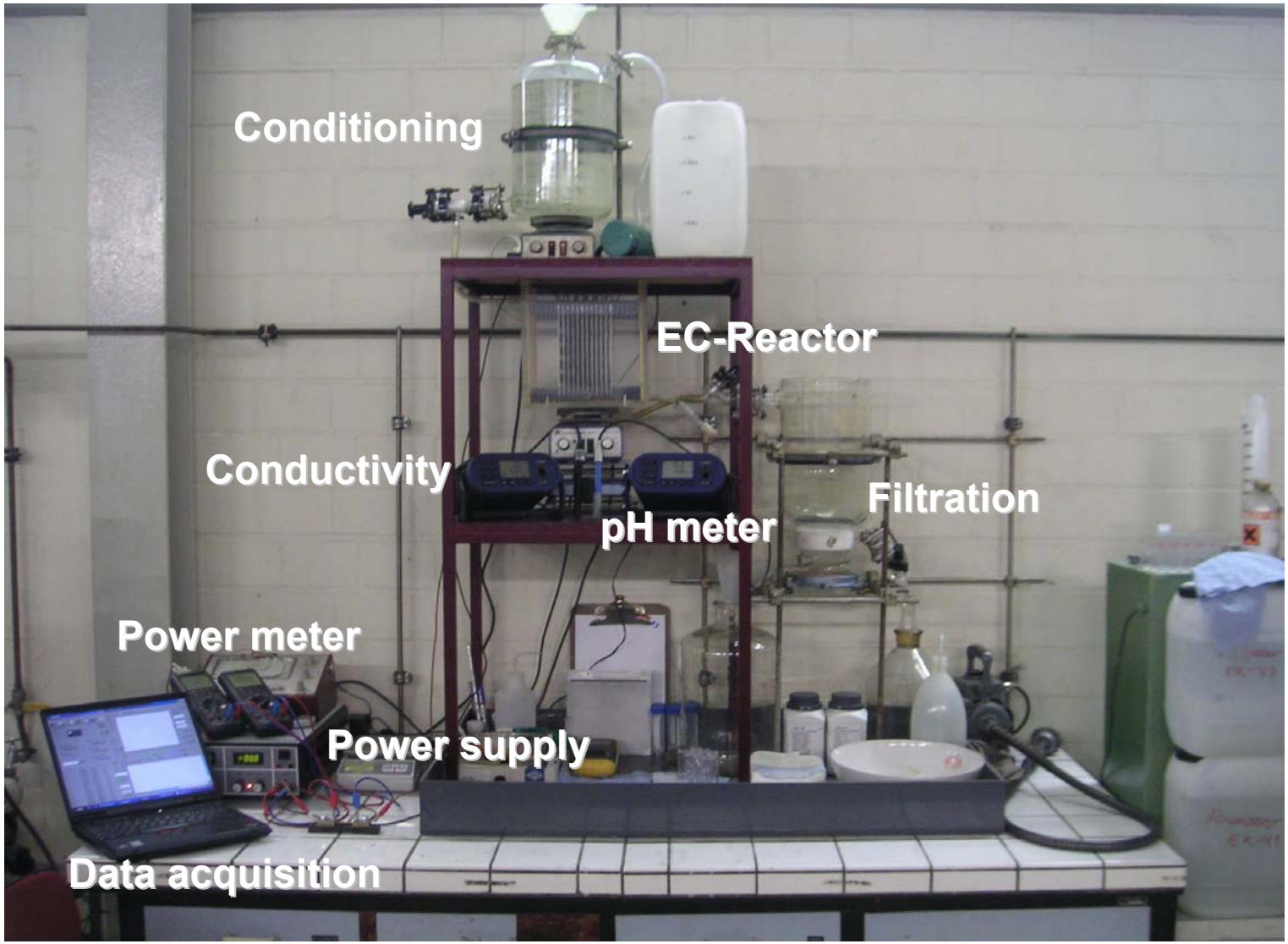


$Al_{24}(OH)_{60}^{12+} \cdot 24\ H_2O$





Wastewater Treat. using an Electrocoagulation System



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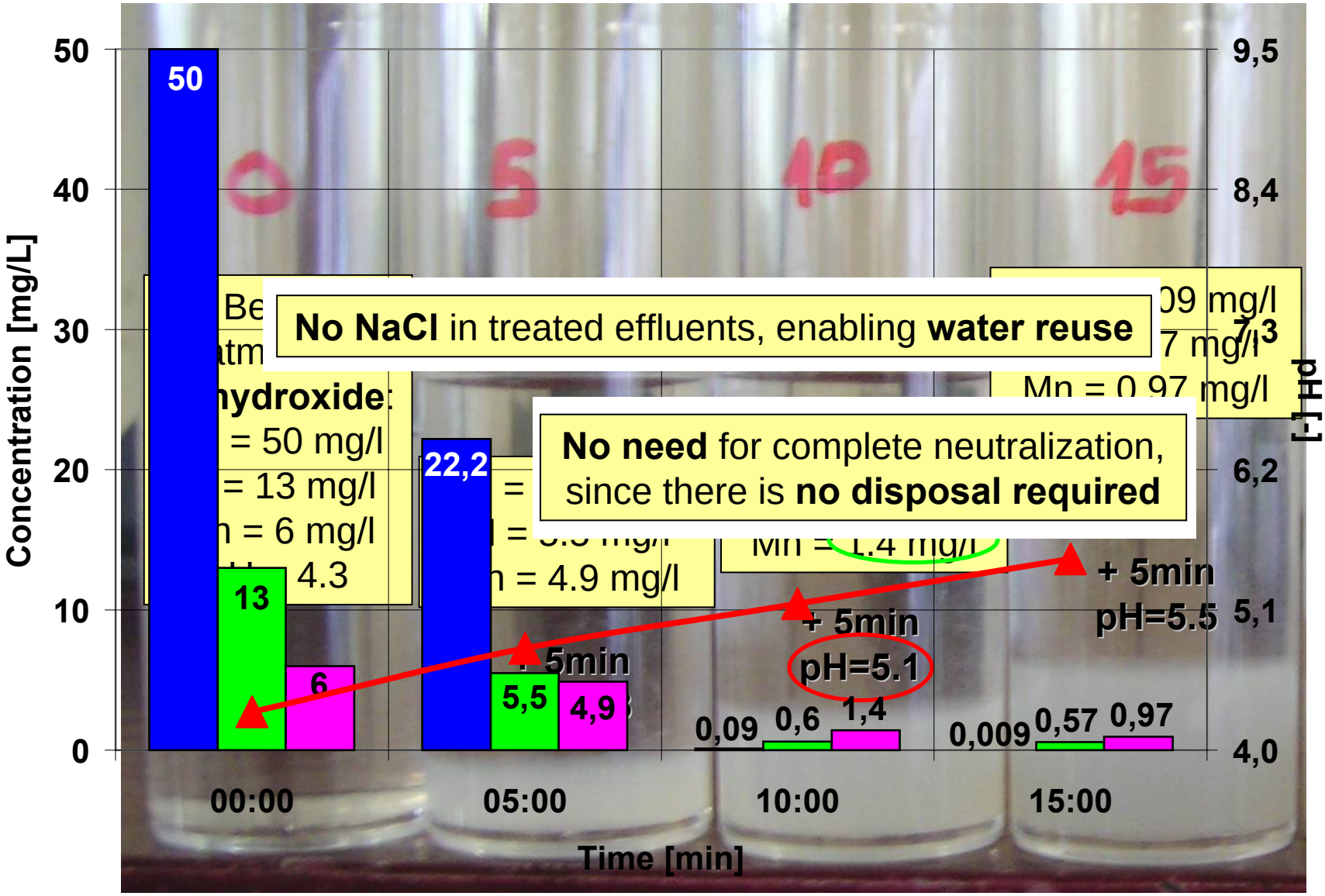
Electrocoagulation Treat. of Copper Production Effluents



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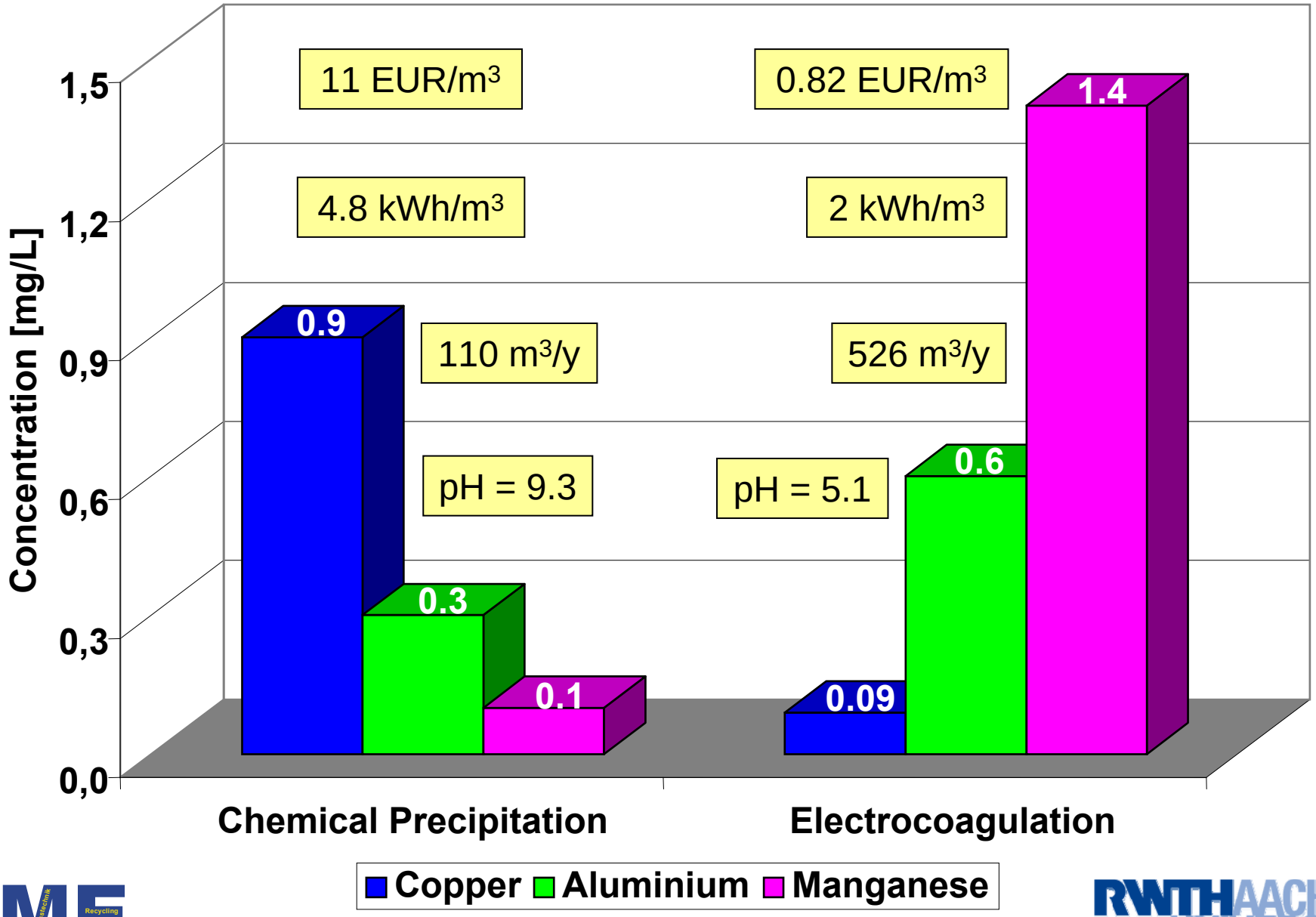
Hydroxide Precipitation vs. Electrocoagulation



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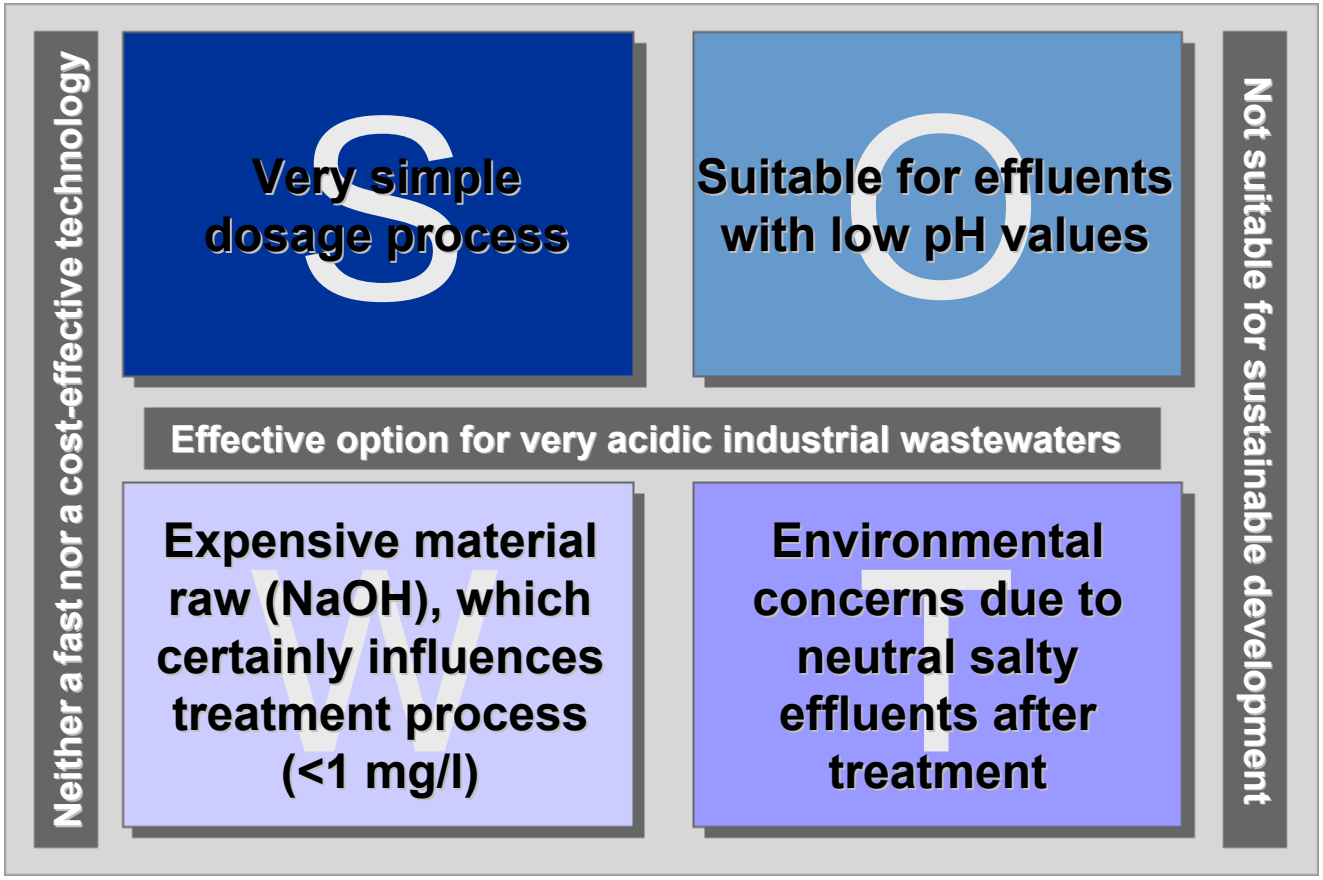
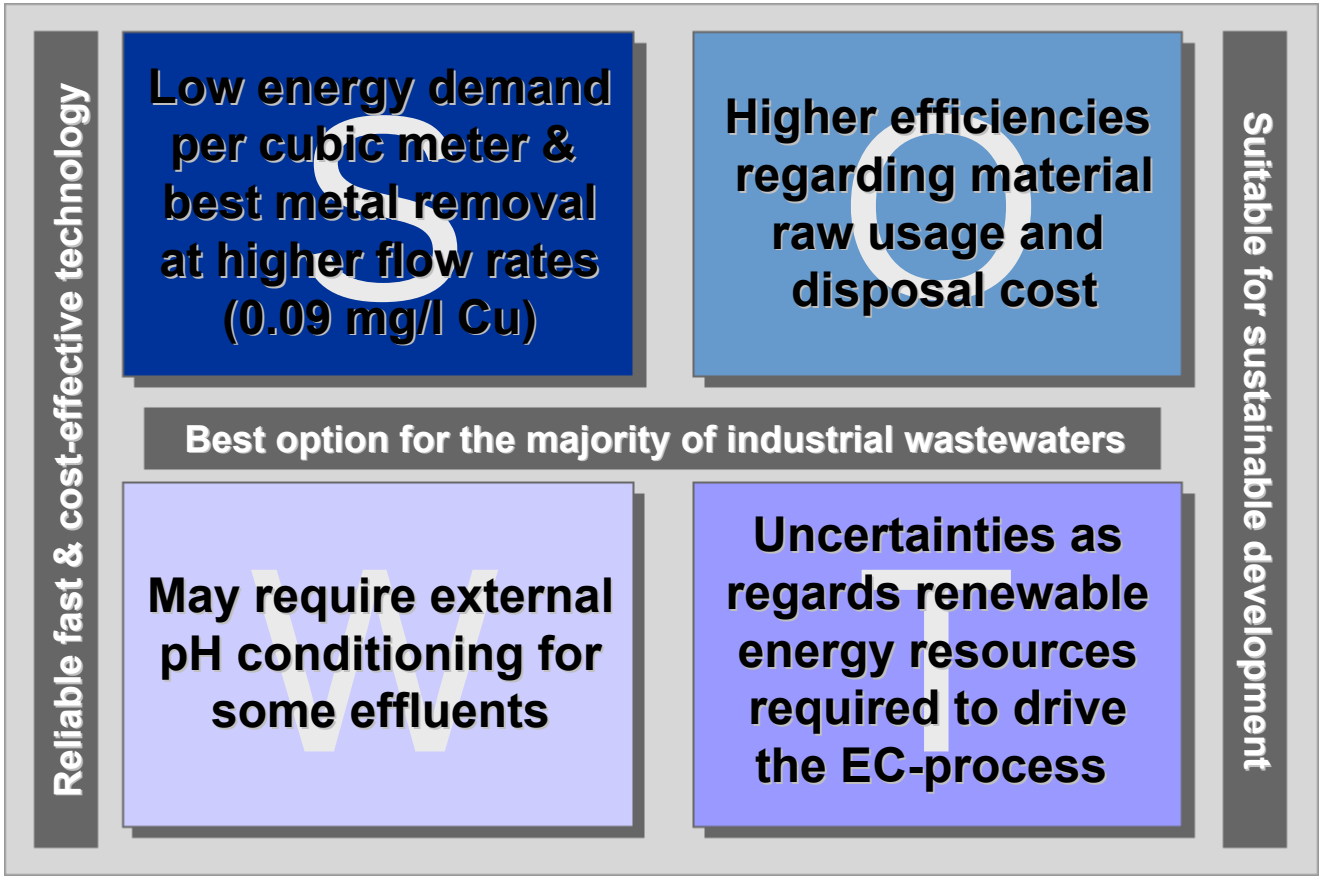
SWOT Analysis – Hydroxide Precipitation



SWOT Analysis – Electrocoagulation



Lack of Efficiency in Municipal Wastewater Treatment

Mechanical Treatment
- Influx
- Sand removal
- Sedimentation

→

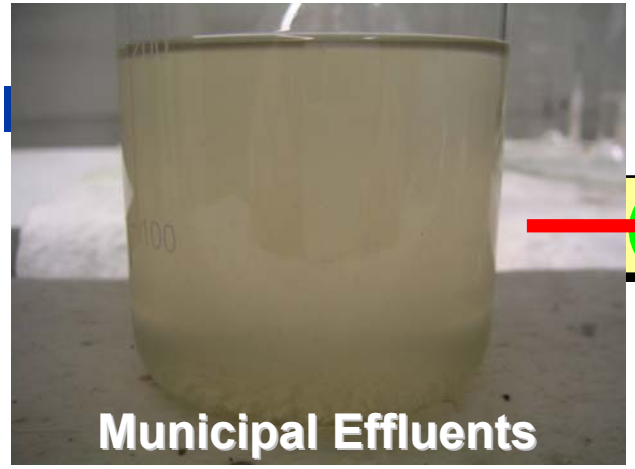
Biological Treatment
- Oxidizing beds
- Aerated filters
- Membrane reactors

→

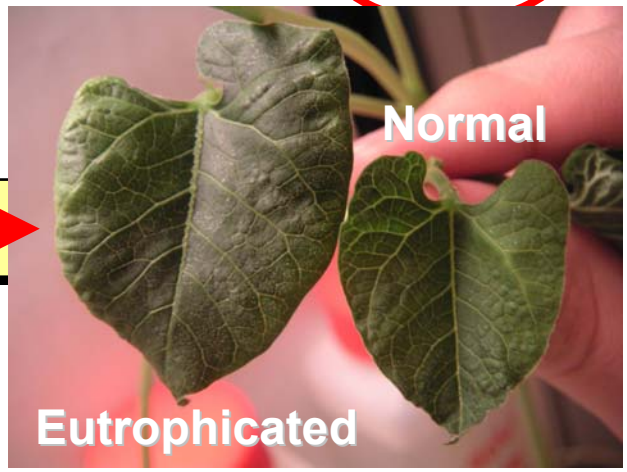
Chemical Treatment
- Phosphorous removal
- Nitrogen removal
- Disinfection

Chemical Treatment

$$Al_2(SO_4)_3 + 16\ H_2O \Leftrightarrow 2\ Al(OH)_3 + 10\ H_2O + 3\ H_2SO_4$$



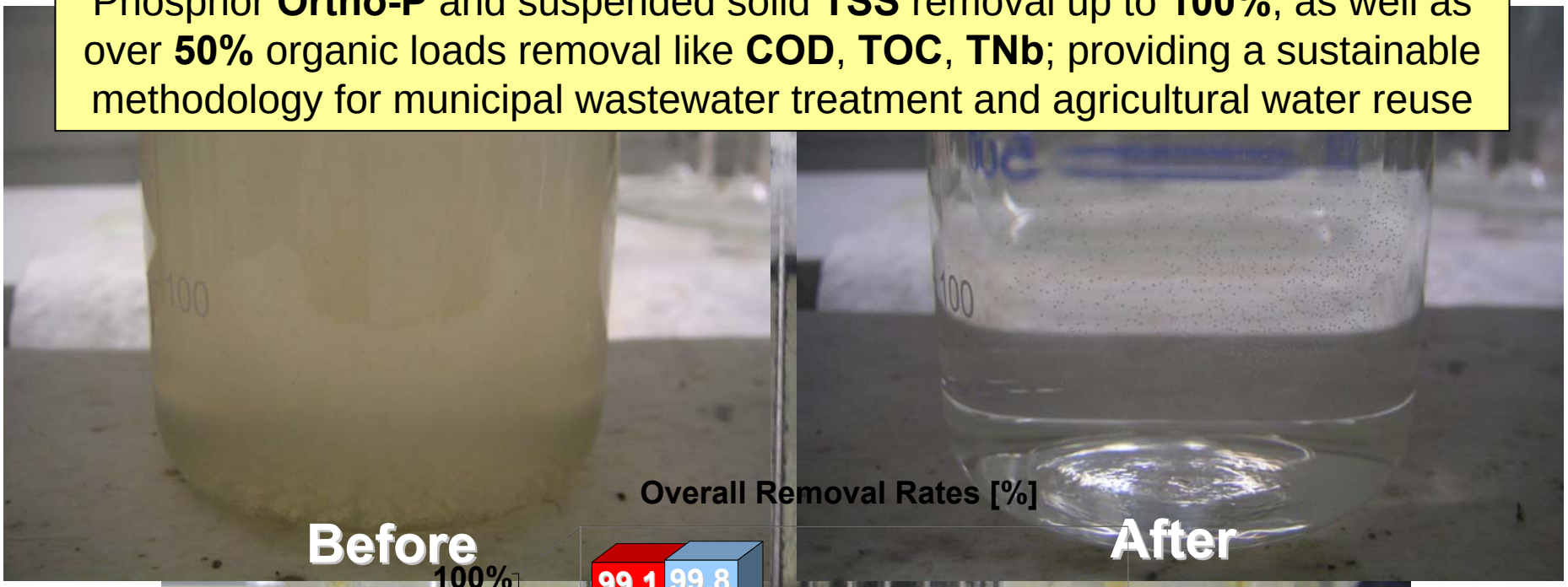
$Al(OH)_2$ (



Excess of nutrients as **Phosphor** and **Nitrogen** causes **Eutrophication**

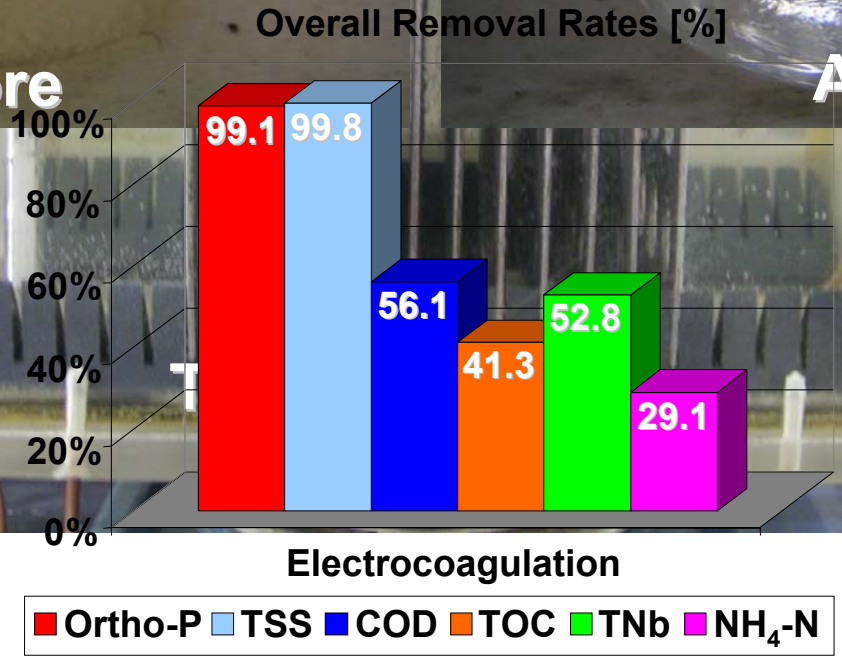
Electrocoagulation Treatment of Municipal Wastewater

Phosphor **Ortho-P** and suspended solid **TSS** removal up to **100%**, as well as over **50%** organic loads removal like **COD**, **TOC**, **TNb**; providing a sustainable methodology for municipal wastewater treatment and agricultural water reuse



Ortho-P = 4,3 mg/l
TSS = 500 NTU
COD = 572 mg/l
TOC = 166 mg/l
TNb = 41.1 mg/l
NH_4-N = 28.9 mg/l

Ortho-P < 0.05 mg/l
TSS < 1 NTU
COD = 251 mg/l
TOC = 97.5 mg/l
TNb = 19.4 mg/l
NH_4-N = 20.5 mg/l



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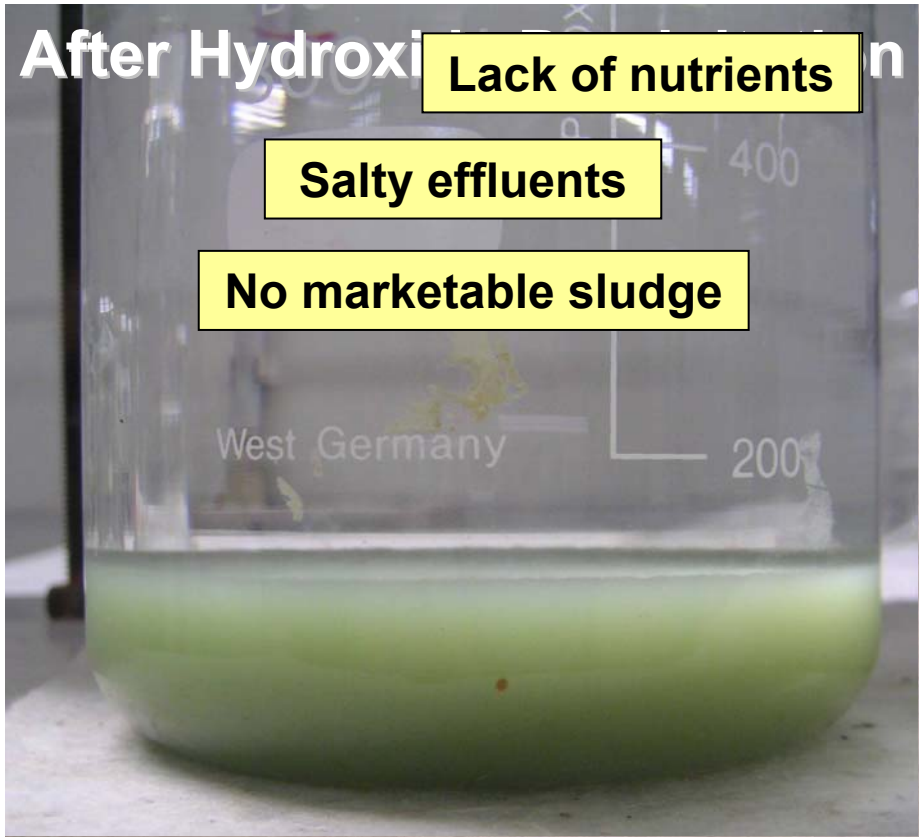
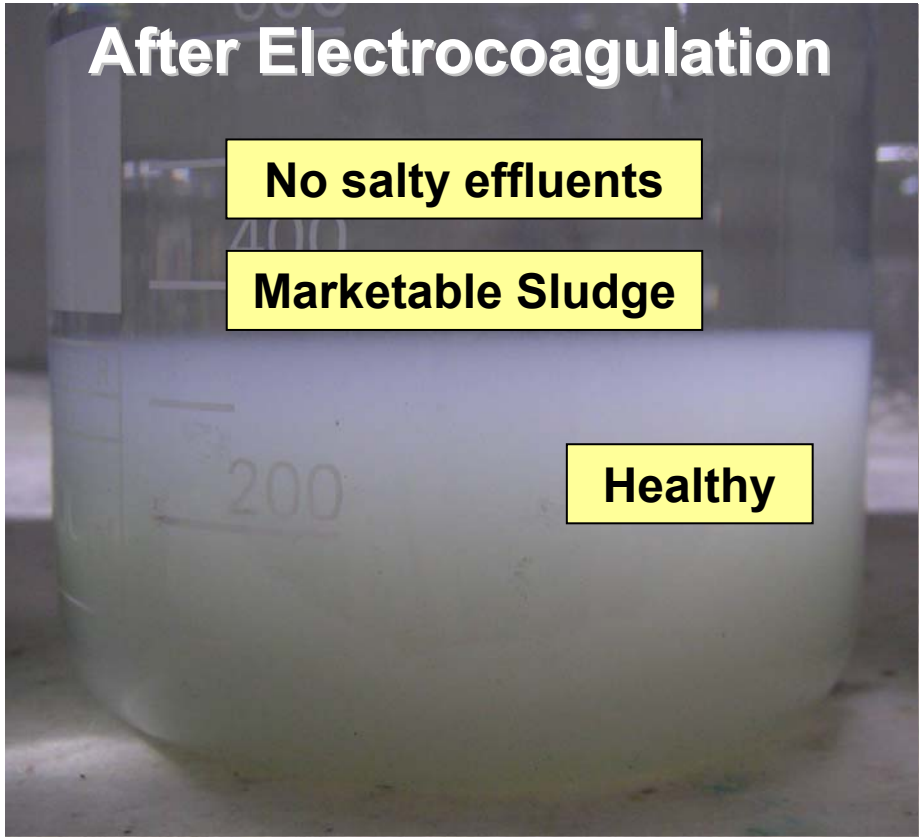
Conclusions – Sustainable Water Reuse Practices





- Higher metal removal rates with no increasing the content of residual salts, enabling greater water reuse practices and providing cost-efficient waste management systems and avoidance of disposal fees

Higher metal removal rates without increasing the content of residual salts, enabling greater water reuse practices and providing cost-efficient waste management systems and avoidance of disposal fees

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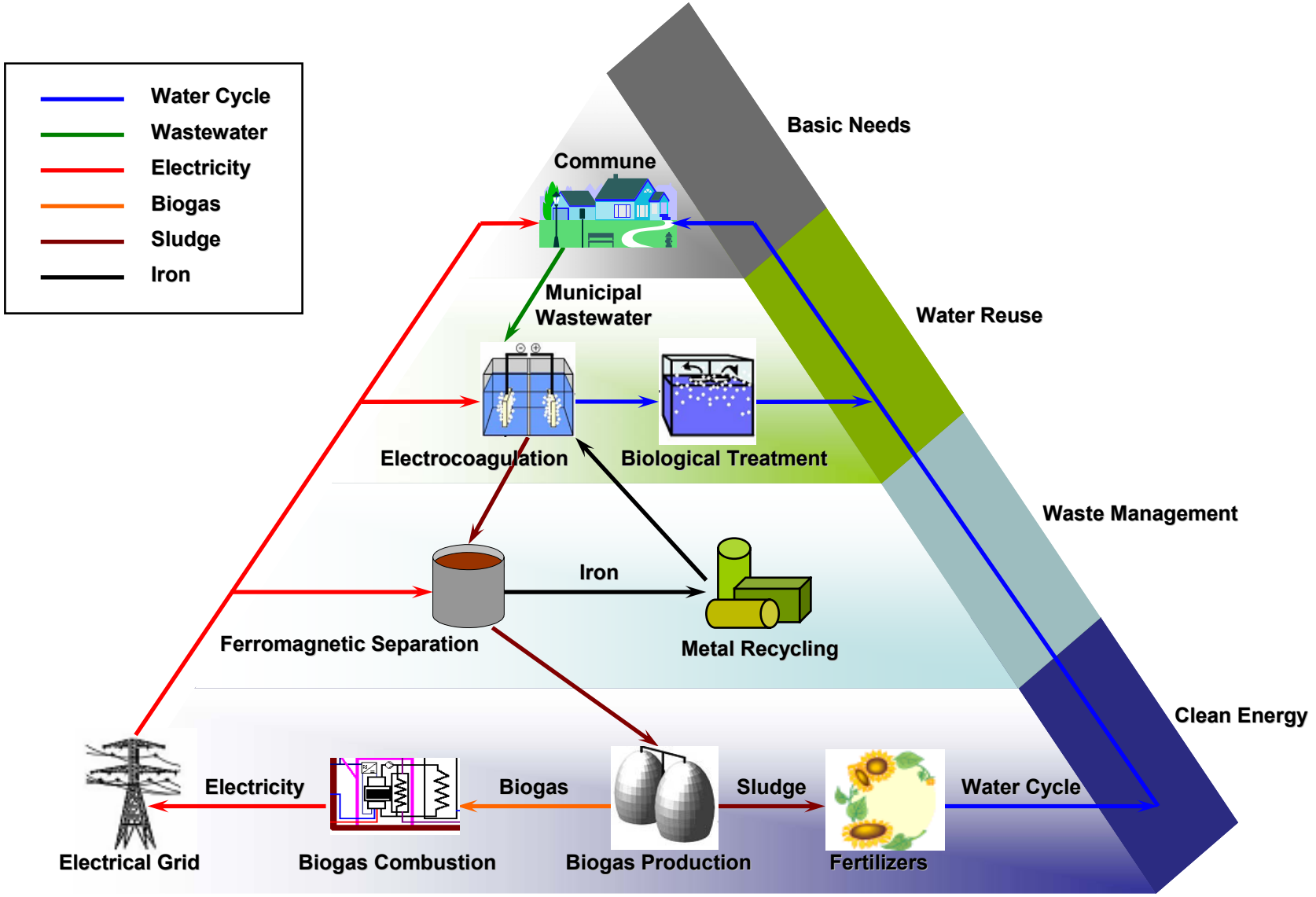
Outlook – Sustainable Water Management Concept



Acknowledgements

Sixth Framework Programme

Improving Wastewater Treatment

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Thank you for your attention.

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