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SHAREBOX on-line training

Water treatment and filtering technologies in the context of industrial symbiosis

Potential of industrial water reuse

- Industrial water consumption makes up 22% of global water use and up to half of the water use in North America and Europe.
- The largest industrial consumers of water are thermal power, iron and steel, paper production, textiles, and petrochemical industry.
- Main industrial uses: as cooling water, process water, aggregate washing, concrete making, soil compaction, dust control
- Industrial water reuse may help reduce water stress rates (ratio between water consumption and water reproduction), which are high to severe in countries like Bulgaria, Belgium, Germany, Spain and Italy.

Examples of direct reuse of wastewater in industrial symbiosis

- Direct reuse, such as:
  - Irrigation
  - Washing
  - pH adjustment
  - Fire protection
- Reuse of organic waste or wastewater for largescale biogas production through anaerobic digestion, which can then be used to generate electricity
- Reuse of wastewater for aquaculture of plants or animals
- Short rotation plantations

Source: Pain, Andrea, and Dorothee Spuhler (2019): Wastewater Reuse in Industry. Available at: https://sswm.info/water-nutrient-cycle/water-use/hardwares/optimisation-water-use-industries/wastewater-reuse-in-industry (adapted)

Opportunities and challenges

Opportunities:

- Reduces the amount of water used.
- Reduces water bills.
- Reduces the volume of generated wastewater (no waste).
- Reduces costs through industrial symbiosis (by-product reuse, sharing management of utilities, sharing ancillary services).

Challenges:

- Requires high knowledge about quality of water for reuse.
- Requires financial investments.
- Requires a high level of trust between industries.
- Requires modification of current operations both for direct reuse and treat-and-reuse.

Source: Pain, Andrea, and Dorothee Spuhler (2019): Wastewater Reuse in Industry. Available at: https://sswm.info/water-nutrient-cycle/water-use/hardwares/optimisation-water-use-industries/wastewater-reuse-in-industry (adapted)

The SHAREBOX approach on wastewater reuse

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Requirements:

- High knowledge about quality of water for reuse
- Modification of current operations both for direct reuse and treat-and-reuse
- High level of trust between industries
- Financial investments

Solutions provided:

- Self-sustaining database for tailored purification and waste treatment technologies
- Safe and discrete web-based resource exchange platform
- Proximity to cluster organizations with access to public funding and private investors

Functionalities of the self-sustaining database

- Large set of physicochemical data on filtration aids and media
  - e. g. surface charge, surface area, pore size
- Depending on an implemented questionnaire, the user will get an initial guess for the best suited purification methods
- If process-specific peculiarities need additional information, the user can be connected to an expert or consultant who will select a potential purification system, define filtration trails or develop a new product to optimize the process

Characterisation of more than 300 filter aids and filter media (1)

Filter aids

						Zeta potential / mV									
Name	Sample -Nr.	Type	Com positi on	Manufact urer / Supplier	Area of use	pH 2 @ 6.15 mS/ cm	Std. dev .	pH 4 @ 2.50 mS/ cm	Std. dev.	pH 6 @ 2.50 mS/ cm	Std. dev .	pH 8 @ 2.50 mS/ cm	Std. dev .	pH 10 @ 2.50 mS/ cm	Std. dev .
Confid	#117*	filter layer	Cell	Confid	chemical industry	2.2	0.8	-1.6	0.8	-4.2	0.3	-6.3	0.4	-8.5	0.3
Confid	#111	filter layer	Cell	Confid	beverages / common filtration	14	1.5	6.9	0.5	-0.4	0.7	-11.2	1.3	-13.8	0
Confid	#125	filter layer	Cell	Confid	beverages	8.4	1.2	3.1	0.2	-9.4	0.2	-12.9	1	-19.7	0.4
Confid	#118	filter layer	Cell / DE	Confid	beverages / common	33	0.4	25.9	0.2	0.2	0.2	-13.4	3	-27.7	1.4

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Characterisation of more than 300 filter aids and filter media (2)

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Filter media

Sample	Name	Composition	density (Framework) / $g*cm^{-3}$	BET / m^2*g^{-1}	Pore volume / cm^3*g^{-1}	Pore size / nm
# 4	Confid	Kieselguhr / DE (fresh water)	2	45	0.14	6.1
# 8	Confid	Kieselguhr (calcined)	2	19	0.07	6.1
# 27	Confid	Kieselguhr / DE	2	0.8	-	-
# 40	Confid	Siliciumdioxide (amorph)	2.2	340	1.11	10.9
# 11	Confid	Kieselguhr / DE	2.3	4	0.02	5.7
# 13	Confid	Perlite	2.5	5	0.01	5.7
# 79	Confid	Zeolite	2.5	6	0.01	5.7
# 14	Confid	Kieselguhr / DE	2	22	0.1	27.4

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Collection of TDS, specs and application reports for approx. 800 filter aids and filter media

market	phase	medium	product name	company	type	impurity	application	filtration range
food and beverage	solid	water	AF ST 130	Jacobi Carbons	filter sheet	particle	decolorisation	microfiltration
chemistry	liquid	ethanol	Becopad	Lanxess	activated carbon	cation	deionisation	ultrafiltration
water	gaseous	organic	EKS 1	Ion Exchange India	IEX	anion	particle removal	nanofiltration
waste water		brine	...	Filtrox	membrane	organic molecule	deashing	reverse osmosis
hydrometallury		non-aqueous		Pall	activated carbon powdered	color	softening	particle filtration
bio diesel				Eaton Begerow	activated carbon granular	taste	de-bittering	adsorption
pharmaceutical				Cabot Norit	activated carbon extruded	odor	...	ion exchange
biogas				Chemviron		heavy metal		...
other stream				...		...		

Technical data sheets available	ZP -pH2	ZP - pH4	ZP - pH6	ZP - pH8	ZP - pH10	Flow rate min l/m2/min	Flow rate max L/m2/min	Retentation range min µm	Retentition range max µm
yes	positive	positive	positive	positive	positive				
no	neutral	neutral	neutral	neutral	neutral				
	negative	negative	negative	negative	negative				

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Description of more than 50 filter equipments and their application

B	C	D	E		G	H
phase	medium	product name	company	type	impurity	application
liquid		Vaccum Belt Filter – HRB	Verfahrenstechnik Tiemann	Belt Filter		Chemical industry ** Paper and sand industries ** FGD systems ** Steel and aluminium plants ** Uranium, copper, nickel, coal and gold mines **
liquid		Vaccum Drum Filter (rotary cell filter)	Verfahrenstechnik Tiemann	Drum Filter		Food industry ** Biotechnology ** Ceramics and electroplating industry ** Tanneries ** Metallurgical industry ** Steel and aluminium plants **
liquid		Clarifier	Verfahrenstechnik Tiemann	Clarifier		Chemical industry ** Environmental e.g. after scrubbers for air purification ** FGD systems ** Metallurgical industry ** Soil, sand, gypsum, lime treatment **
liquid		Electroflotation	Verfahrenstechnik Tiemann	Electroflotation		The MORSELT REDBOX can remove a variety of substances from wastewater. In addition to safe and highly efficient removal of heavy metals, glue and glue residues, colours and suspended solids and a variety of other dissolved substances can be removed from industrial waste water. ** Electroplating industry ** Metal-working industry ** Packaging industry ** Textile finishing ** Colour and paint industry **

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Literature for further studies

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The project: SHAREBOX

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http://sharebox-project.eu

Secure Management Platform for Sharing Process Resources

- Joint project funded by EU (Horizon 2020)
- 16 project partners from 8 countries
- EC funding (A): 5.416.544,75 €
- Private investment (B): 1.500.000 €
- Funding period: 2015-2019

Funded by the Horizon 2020 Framework Programme of the European Union

SPIRE
Sustainable Process Industry through Resource and Energy Efficiency

www.spire2030.eu

Authors of this presentation

- Ansgar Rudolph

Zurich University of Applied Sciences
Life Sciences and Facility Management
Institute of Natural Resource Sciences

- Jürgen Ebert
- René Itten

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