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Innovative and sustainable solutions in the steel industry: new developments in water management

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Situation - Solutions





SPOTVIEW: Holistic view of a site including water sources



Water use in steel industry

- Cooling applications (material: casting, hot rolling; machines): 75%
- Gas washing (blast furnace, basic oxygen furnace): 13%
- Material conditioning (e.g. slag granulation):
 12%



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Situation

- Process related intake of solids and organic causing wear and biological activity
- Concentration of salts/hardness components leading to corrosion and scaling
- Addition of treatment chemicals: corrosion inhibitors, antiscalants and biocides
- Decreasing/stronger limited water availability in semi-aride areas

Challenge

- Complex and varying water matrix causing insufficient economic/technical levels of available water treatment technologies and preventing water reuse
- Components mostly inhibiting water reuse: chloride, sulphate, hardness, oil, solids and possible interactions of technologies with treatment chemicals

Solution

- Use of innovative technologies as capacitive deionisation, precipitation reactor (softening, disinfection), magnetic separator and water management (cascade)
- Determination of concerted combinations of water treatment chemicals (e.g. flocculent, biocide), solid removal and desalting/softening technologies



Aims / Focus INSPIREWATER - SPOTVIEW



Global project aims

- Saving of fresh water and reduction of waste water
- Decoupling of production and fresh water demand

INSPIREWATER- focused view on a selected circuit

 Decrease of corrosion and scaling by use of suitable technologies for longer water use reducing the freshwater demand/waste water occurrence

SPOTVIEW - holistic view of a site including water sources

- Reuse of low loaded waste/process water in a cascade considering the required water qualities
- Recycle of loaded waste/process waters as e.g. back wash water from sand filters by e.g. solid and salt removal for an internal reuse
- Use of alternative water sources (sea / rain water) or optimization of river water treatment by innovative desalting technologies as capacitive deionization





Innovative technologies



Investigated Innovative Technologies











Magnetic separator:

Chemical free and pressure less solid removal with permanent strong field magnets

Combined flotation / microfiltration

Oil and suspended solid removal by flotation with rotating discs followed by microfiltration

Capacitive Deionisation

Ion removal by electrostatic adsorption at electrodes and subsequent desorption during regeneration

Innovative Reactor

Input of highfrequency electrical pulses to hindrance bacteria adaptation and changes of forces of repulsion balance for "not sticking dust"





Results



Demonstration of selected technologies at AM Gijon



Magnetic separator

Reverse Osmosis

Innovative reactor

3layer-filtration



Direct cooling water









3layer filtration Reverse Osmosis Magnetic separator 25.03.2020 Innovative and sustainable solutions in the steel industry - new developments in water management



Summary of technical results - INSPIREWATER-



Magnetic separator:

- Treatment of approx. 31,000 m³ cooling water
- Outlet solid contents down to 10–15 mg/L (LOD: 10 mg/L) even in case of about factor 3 -5 varying inlet solid contents
- High solid contents in sludge between 19–31 wt.-% compare to 0.2 wt.-% at 3layer-filtration or operations and filter
- Low ratio of back flush water to treated volume with 0.001 0.006% compared to 1.2 – 4.3% for 3-layer-filtration or operations and filter

3layer filtration:

- Confirmation of lab results achieving outlet solid contents below 10 mg/L.
- Increased removal efficiency from 65% to 96% by 3layers of different filter material compared to operational sand filter or up to 83% by decreasing velocity

Reverse osmosis:

- Flux up to 50 lm²/h possible in case of pH-adjustment and concentration factor 4
- Significant decrease of corrosion potential compared to untreated water

Innovative reactor: Inconclusive results in field and lab trials

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WATER Applications for reuse back Spot View wash / river water /sea water

		Back wash	Pivor wator	Soa Wator
		Water	River water	Sea Waler
Hot Rolling Mill	Reheat furnaces	pH adjustment		
	Equipment cooling			
	Direct cooling	nH adjustment		
Continuous Casting	Mould cooling	necessary		
Circuits	Contact cooling	necessary		
Electric Arc	Indirect closed cooling	Further s	Further softening required	
Furnace (EAF)	Open cooling			
Converter Circuits	Indirect cooling			
Blast Furnace Circuits	Indirect cooling			

- CDI treated river and two steps RO treated sea water <u>can be directly for</u> <u>all applications beside indirect closed loop cooling at the electric arc furnace</u>
- Direct use of CDI treated back wash water in: cooling processes in hot rolling mill, EAF and blast furnace possible - pH-adjustment from 6.5 to 7 or 7.5 necessary for further applications



Summary of technical results - SPOTVIEW-



Back washing water treatment

 Suitable combination: flotation/microfiltration (oil/solid removal) flowed by CDI or RO for desalting/softening in 3 month field trials

Technology	Water Recovery [%]	Energy Demand [kWh/m ^{3]}	Quality	
Flotation with MF	89	0.3	TSS< 3mg/L	
CDI	78	0.95	Fulfilling AM requiremrents: Conductivity: < 200 µS/cm Chlorides: < 50 mg/L	
RO	85	1.4		

River water treatment

 CDI: fulfillment of AM requirement with water recovery of 79% and 0.95 kWh/m³ - same as RO/IX

Sea water

- Multimedia and Ultrafiltration fulfills turbidity requirement (< 1NTU).
- Two RO passes required (water recovery: 40%, energy demand: 4 kWh/m³)

Cascadic Water Reuse – 9 possible applications in the area cooling water

- 10 31% water saved from direct reuse applications without any treatment.
- CDI treated back wash water: direct in 4/9 or after pH-adjustment in 2/9 cooling water applications - treated river water in 8/9 cooling water applications
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Summary of technical results and evaluation



Evaluation of project results



INSPIREWATER

- 66% energy saving by use of pressure less magnetic separator for solid removal compared to pressurized sand filter
- 80% blow down saving and up to 13% fresh water saving by RO treatment of the blow down waste water reduction by removal of solids, salts and hardness components

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- Between 10 and 30% fresh water saving by reuse process water and further 38% by desalination technologies.
- 89% reduction of backwash water by solid and desalination to recycle back into the process.
- Reduction of dependency on fresh water availability and minimization of fresh water use per ton of steel of 50% by using alternative water resources.





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