Water footprint as an environmental tool
- Case Finnish forest and mining industry

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What is water footprint?

WATER FOOTPRINT IS AN LCA BASED TOOL TO EVALUATE THE LOCAL IMPACTS OF WATER USE BASED ON VALUE CHAIN APPROACH
ISO 14046: Water footprint - principles, requirements and guidelines

- Compatible with ISO 14040, 14044 LCA standards
- Water footprint is an impact (not a volumetric inventory)
- Local aspects of water availability
- Water quality changes are as important as water availability
- Positive aspects can be reported separately
- Practical examples how water footprint is calculated will come out as a separate Technical Report
Why water footprint is important for industry?

- **Water is a major global issue:** strong concerns of the water resources and water quality create needs to guide the development of "water-saving" products and technologies.

- **Key industries:** food, chemical, textile, mining, forest, oil and gas and power production industry.

- **In the Northern countries:** water is normally abundantly available and water footprint may seem irrelevant.
Case: Mining industry in Finland
SAM – Sustainable Acceptable Mining

- SAM (2013-15) is a sustainability project with a multiscience approach.
- Several Work packages that cover technology foresight and the three elements of sustainability. Regional approach is essential.
- Main focus is on social licence to operate. Environmental sustainability is focused on water, economic sustainability focused on new sustainable business and service concepts.
- Interaction with industry (case studies), its stakeholders and research. International cooperation.

Focus on the whole life-cycle of mining:

- OPERATIONAL PHASE: Eco-efficiency, environment
- PRE-OPERATIONAL PHASE: Social licence to operate, planning process
- POST-OPERATIONAL PHASE: New business and service concepts
Case: Pyhäsalmi copper mine (First Quantum Minerals, Finland)

- The goal was to assess potential impacts related to water use associated with production of copper concentrate at underground Pyhäsalmi mine.

- The form of this study is water availability footprint, focusing on consumptive and degradative use of water.

- The functional unit is expressed as t copper anode.

- The system boundary include chemicals, materials, energy and fuel production and the smelter.
Water balance Pyhäsalmi site

INPUT = OUTPUT

Mine water

Surface water

Ground water

Natural Drainage waters

Rainfall

Evaporation from process

Water in concentrate

Water in By-products

Water in tailings

Evaporation from ponds

Ponds

Treated effluent
Water availability footprint

Chemical 1
  - Location
  - Quality
  - Quantity

Chemical 2
  - Location
  - Quality
  - Quantity

Chemical 3
  - Location
  - Quality
  - Quantity

Energy
  - Location
  - Quality
  - Quantity

Material 1
  - Location
  - Quality
  - Quantity

Material 2
  - Location
  - Quality
  - Quantity

Copper mine
  - Location
  - Quality
  - Quantity

Copper refinery
  - Location
  - Quality
  - Quantity

Product: 1 t copper anode

Quantities:
- Input, m3
- Output, m3

Quality:
- Water availability

Location:
- Input
- Output

etc…

Chemicals, materials, energy
How much fresh water is withdrawn, released and consumed in the value chain?

38% evaporated
12% integrated to by-products and tailings
11% integrated to concentrate
39% temporarily accumulated in ponds

- Each ton of produced copper anode product generates a water stress equivalent to **240 liters H₂O eq**.
- This is how much other water users would potentially be deprived.
- 56% of the stress impact of copper anode product is caused by the mine operations, 37% by chemicals and raw materials production

(Comparison: Board (Finland) **70 l H₂O eq/t**, Board (avrg Europe) **370 l H₂O eq/t**)
Challenges

- How to define the quality on the input mine waters (levels of metals can be naturally high)
- How to define the functional unit: economic seems to be the most feasible
- Defining the supply chain (e.g. chemicals OK, products difficult)
- Impact assessment characterization factors: In commonly used eutrophication impact assessment, only P emissions are accounted for freshwater. N emissions can be high in mine waste waters

Is data a challenge?

Relevant regional/national data is needed: inputs and outputs on watershed level (volume, source, and quality) → further development of characterization factors
Case: Forest industry in Finland
Industry’s pilot studies provided a starting point

Pilot studies of the Finnish forest companies created a need to better understand water footprint and its components. Data for the value chain and the process itself existed but the main concern was whether the water footprint correctly reflects the ‘green water use’ (evapotranspiration) in forestry.

Source: UPM, 2011
Water footprint in Finnish BioCluster project EVERGREEN 2010 – 2013 (UPM, MetsäGroup, Finnish Forest Research Institute)

- Water footprint should serve as sustainability tool but also as management tool.

- Water footprint should evaluate whether the impacts are harmful, neutral or beneficial.

- Water footprint should tell about impacts instead of volumes, such as impacts on land use, biodiversity, run-off, surface and ground water quality and availability, etc..

- **Research question**: How to define and take account the natural water cycle and regional water availability in product water footprint?

  **We need hydrologic science (models and experimental data)!**
Hydrologic cycle in water footprint

- Definition of green water “use” is scale-dependent: use at small scale is part of natural hydrologic cycle in the earth.

- Evapotranspiration (ET) can’t be regarded as a ‘loss’!

- Instead of considering total amount of green water (evapotranspiration) one should look the local impacts of green water use, e.g in boreal forests

- Local water availability effects water use impacts (should be reflected in product water footprint)

Case magazine paper: Water eutrophication footprint

- Phosphorus, nitrogen and suspended solids were selected as a set of indicators to describe the change in water quality due to eutrophication
- Based on paper product’s life cycle:
Case magazine paper: Water eutrophication footprint by source

**Suspended solids**
- 1.4 kg/t paper

**Phosphorus**
- 0.06 kg P eq/t paper
  - 47% Pulp & paper mill
  - 27% Fiber raw material
  - 22% Non-fiber raw material
  - 1% External purchased

**Freshwater eutrophication [kg P eq]**
- 64%

**Scenario:** Silviculture as usual

**Nitrogen**
- 0.26 kg N eq/t paper
  - 81%

**Marine eutrophication [kg N eq]**
Footprints and industry’s environmental communication
Water footprint is a simplified indicator

- Few details are required for easy communication
- ...but complex processes comprised in oversimplified result may require much additional information to be understood correctly
- Process specific data needed
- Communication should be based on facts and science
- Water footprint should be included as a part of the technology development

The entity matters

- Water is just a single resource; sustainability needs to be considered broadly
- A toolkit of sustainability methods should be used, e.g. how is water linked with climate change, land use etc..
- Water risk assessment, water eco-efficiency and economic savings
THANK YOU!

ASK MORE!

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