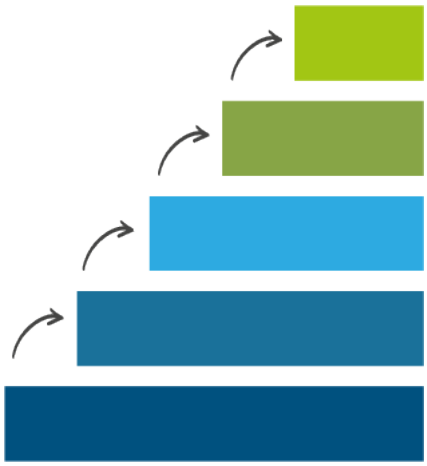
BALTIC INDUSTRIAL SYMBIOSIS

Generic case

SYMBIOSES WITH SECONDARY WATER



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THE MAIN POINTS

Secondary water symbiosis creates both economic and environmental benefits. Many industries generate a variety of water fractions of variable quality, which can be utilized in other companies' production instead of groundwater.

Secondary water is a common term for water of a different quality than drinking water; it can be both low or high quality of water. Numerous industries generate secondary water, for example, industrial process wastewater or water supply wells. Typically, secondary water is sent to municipal wastewater treatment plants as wastewater or discharged directly to the environment. However, there are alternative uses for secondary water, for example, water of high purity is reused for purposes where this water characteristic is essential. Water of lower quality than drinking water can be used instead of drinking water, where e.g. there is a requirement that equipment should not get clogged up.

UTILIZATION

Secondary water can be sent to another company and utilized in:

- Production processes or in products
- Washing, rinsing and cleaning
- Cooling and heating
- Power and heat production

GREAT SAVINGS

There are significant financial benefits to be gained from a secondary water symbiosis in the form of savings on water procurement and lower costs related to wastewater disposal. There can also be savings due to less water treatment at a receiving company if secondary water has a higher quality than drinking water. An industrial symbiosis can thus help reduce companies' operating costs, thereby strengthening their bottom line and competitiveness.

The gains are usually highest when two companies are physically close to each other or in case of large quantities of water. Besides the economic benefits, groundwater is saved.

SECONDARY WATER

Secondary water is defined as water of a different quality than drinking water. Therefore, secondary water can come from a wide variety of sources.

In connection with industrial symbiosis, secondary water can be:

- Process wastewater from industries
- Purified wastewater from industries
- Groundwater from gravel pits, limestone pits, quarries etc.
- Water from wells
- Rainwater from roofs or paved areas

Water from the sources mentioned above is typically sent to sewage treatment plants, where a company must pay water drainage fees, or directly to the environment (the recipient). Therefore, secondary water is well suited to be included in industrial symbiosis where, through alternative utilization, increased economic and environmental value can be obtained. In general, water flow used as a secondary resource should be separated from a company's other wastewater flows, so it is known where this wastewater originates, and it does not contain water from, e.g. toilet flushing.

Water characteristics are crucial to the purposes the water can be used for. There are different parameters which can describe the characteristics of secondary water and its utilization. These are physical (e.g. smell, color and temperature), microbiological (e.g. E. coli) and chemical (e.g. chloride, iron, nitrogen, environmentally friendly substances, etc.).

For example, these parameters affect the possible duration of water storage. If a selling company does not generate secondary water at the same time as a receiving company uses it, countervailing tanks are required. In this case, it is essential to be aware of the microbiological parameters.

The water can contain harmful bacteria, which increases in number over time if no disinfection is undertaken.

Therefore, in a water symbiosis, a concurrence between the production and the need for secondary water should be sought to maximize yield and ensure a sustainable economy.

The chemical parameters affect, among other things, whether there are salts that can precipitate and thus clog up equipment. The chemical parameters also affect how corrosive the water is and whether the water can be discharged directly to the environment or must be purified at sewage treatment plants.

On the next page you can see different sources of secondary water as well as its characteristics in terms of availability, suitability for storage and physical, chemical and biological parameters[1].

[1] Adapted from the Danish Nature Agency (2014). Udregning om brug af sekundavand i Danmark. Miljøministeriet, København

SOURCES OF SECONDARY WATER

Water sources / Assessment parameters	Dewatering/ remedial pumping	Fresh surface water	Salt surface water	Purified wastewater	Process wastewater	Rainwater from roofs	Rainwater from paved areas
Accessibility	✓	✓	✓	✓	✓	•	•
Suitability in terms of storage	✓	•	•	○	➢	✓	✓
Quality in terms of physical parameters	✓	•	✓	○	➢	✓	•
Quality in terms of microbiological parameters	✓	•	•	○	➢	•	•
Quality in terms of chemical parameters	•	•	○	○	➢	✓	✓
Quality in terms of environmentally harmful substances	•	✓	✓	○	➢	✓	○

- ✓ Suitable as SECONDARY WATER
- • Less suitable as SECONDARY WATER
- ○ Most often unsuitable as SECONDARY WATER
- ➢ Suitability depends on the water source

UTILIZATION

In the following, various utilizations of secondary water are reviewed. Opportunities, which typically impose the strictest requirements on water characteristics concerning chemical, physical and microbiological parameters, are presented first.
In order to achieve the most significant economic gain, secondary water must be utilized as optimally as possible. It can be illustrated as a pyramid, where each level represents exploitation with higher economic and environmental value. It means that the highest value is obtained by using water with the most favorable characteristics. For example, softened water is used for purposes that require it, rather than for purposes where water these characteristics are not as significant.

INDUSTRIAL PROCESSES

Requirements for secondary water used in industrial processes or directly in products vary considerably from industry to industry.

The food and pharmaceutical industries are major consumers of water; their production typically requires very high-quality water, but since companies often have their own water treatment facilities, these industries can be potential recipients of water of lower quality than drinking water from waterworks, as water is still undergoing advanced purification processes. It can lead to increased costs for water treatment - but can be profitable from a total economic point of view.

WASHING, RINSING AND CLEANING

Secondary water can also be used for washing, rinsing and cleaning. Often, for washing, softened water is used, where lime is removed to avoid precipitation and increase washing efficiency.
Washing water with limited contamination can be reused for washing and rinsing in industries that do not impose high purity requirements.
For example, it can be utilized for vehicle cleaning.

Often, due to restrictive legislation, secondary water cannot be used for washing, rinsing and cleaning in the pharmaceutical and food industries, unless it is of drinking water quality or better.

COOLING AND HEATING

Secondary water is suitable for industrial cooling. The water must not contain particles or salts that can precipitate and thus cause clogging in the cooling equipment. But there are no special requirements for water quality.

Water from, for example, groundwater basins or offshore wells is typically extracted from underground at a temperature that is lower than ambient temperature. The low temperature of the water means that it can be used for free cooling. It can displace the energy used, for example, to operate a compressor in a traditional cooling system.

EXAMPLE - WATER SYMBIOSIS FAXE

Royal Unibrew (beverage provider), Faxe Kalk (supplier of lime, limestone and clay products), Faxe Vandforsyning (water supplier) and Haslev Fjernvarme (district heating) are willing to establish two symbioses with secondary water.

1. Surplus water from Faxe Kalk's wells can be used as natural cooling water at Royal Unibrew as an alternative to the more expensive water evaporation for cooling

2. Water from Faxe Vandforsyning's offshore wells (pumped up to reduce pollution from spreading to the water supply) is utilized as dilution water at Haslev Fjernvarme

Thus, the symbiosis partners save costs on obtaining or purchasing water and energy, thereby ensuring a significant financial gain.

EXAMPLE - WATER RECYCLING FOR TRAIN WASH

Berendsen in Holbæk washes, supplies and handles textile and hygiene solutions. The company handles special coats and working clothes, which require cleanliness.

The neighboring company Regionstog in Holbæk is responsible for train operation on the Odsherred and Tølløse railway lines. It includes washing, maintenance and repair of 13 train sets. Berendsen generates wastewater in connection with the washing process. This wastewater is softened so that lime does not precipitate, and the water also has a low residual soap content. Currently, this water is sent to the municipal wastewater treatment plant. However, Regionstog can utilize the water for washing train sets to replace the drinking water from the municipal waterworks that the company uses today, thereby ensuring a significant financial gain.

Secondary water can be used for heating by using a water stream as an energy source for a heat pump. With a large amount of water, significant energy yield can be achieved by lowering the temperature of the water by a few degrees. This energy yield can be utilized either internally or can be delivered as district heating and/or to neighboring companies.

POWER AND HEAT PRODUCTION

Secondary water can be used in power and heat production. As an example, dilution water utilized in district heating production in the water symbiosis in Faxe, which is reviewed in the cases below. Secondary water can also be used in connection with, for example, flue gas cleaning.

In Denmark, there are no legal barriers to using secondary water in power and heat production, and therefore, its use is already relatively widespread.

ECONOMIC PROFIT

If two companies are involved in symbiosis, where secondary water from one company is used for process or other purposes at the other company, the first company saves on the water drainage charge and the second company saves on water. Additionally, potential savings can be achieved by reducing the need for water treatment if, for example, a company receives softened water. For companies with large water consumption, it can lead to significant financial gain.

In Denmark, the water drainage charge and the water price vary from municipality to municipality. The wastewater utility companies charge a variable water drainage fee according to the so-called "staircase model", where companies with high water consumption pay less than companies with low water consumption. However, as a rule, the water drainage charge is considerably higher than the water price.

For companies with high cooling needs, the utilization of secondary water for cooling can mean significant reductions in operating costs, as substantial amounts of energy can be saved.

Regarding the previously mentioned symbiosis examples, in Faxe water symbiosis, Royal Unibrew saves on purchase of 16,000 m3 of water annually and achieves a saving on electricity used for cooling. Also, Faxe Fjernvarme saves 6,000 m3 of water by using water from the offshore well.

By utilizing secondary water for washing train sets, Berendsen saves the water drainage charge, and Regionstog saves on water purchase. It is expected that the two companies can achieve a total annual saving of approx. EUR 5,356. This saving makes it economically viable to establish a pipeline between the two companies.

ENVIRONMENTAL VALUE

By using secondary water in production, it is possible to save on natural resources - in this case, groundwater. In Denmark, more than 95% of drinking water comes from groundwater resources. This resource is beneficial as water of such high quality requires only minimal treatment, typically in the form of oxygenation and filtration. On the other hand, more and more Danish groundwater wells are closing due to, among others, pesticides found in water.

Non-contaminated groundwater is a limited resource in several places in Denmark. Besides, reuse of secondary water means savings on water treatment at a water treatment plant, which is an energy-intensive and costly process.

The energy gain comes from reduced need for pumping, filtration and more, which leads to a reduced demand for supplied energy.

If this energy is produced on fossil fuels, greenhouse gas emissions are reduced, e.g. in the water symbiosis in Faxe, a reduction in CO_2 emissions is of approx. 280 tons per year, as Royal Unibrew saves energy on cooling.

BARRIERS

There are several different technical and/or regulatory barriers that can make it challenging to establish symbiosis with secondary water. Typically, the boundaries are whether the characteristics of the water meet the receiving company's requirements as well as the two barriers described below.

HIGH INSTALLATION COSTS

The main barrier related to symbiosis with secondary water is construction costs related to establishment of water pipes between two or more companies. The prices vary depending on where the pipeline is to be established and the amount of water to be transported. The higher the amount of transported water, the more significant financial gain a symbiosis will create and thus reduce the payback period for the establishment of water pipes.

LEGAL BARRIERS

Applicable legislation must be considered if a company is willing to use secondary water rather than drinking water, and law varies according to the application of water and the type of business. For some purposes (e.g. heat production and cooling) there are no legal barriers.

If a company wants to use secondary water for rinsing and cleaning, it depends on the type of industry, which legislation is in force.

LEGISLATION FOR USE OF SECONDARY WATER

The following legislation can be relevant for industrial symbiosis with secondary water:

- The Drinking Water Ordinance (requirements for companies that produce medicine and the like)
- EU Hygiene Regulation (concerning the food industry)
- The Wastewater Ordinance (requirements for wastewater discharges relating to, for example, metals and hazardous substances)

This case reviews symbiosis possibilities for secondary water and aims to inspire better utilization of this residual by describing options and benefits of such symbiosis. Please, do not use the case as a design or decision basis.

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