

FP7 EU PROJECT AQUAFIT4USE-SYNERGY OF 4 INDUSTRIAL SECTORS WITH THE GOAL OF WASTE WATER RECYCLING

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Abstract:

Sustainable water use in industry is the goal of AquaFit4Use, by a cross-sectorial, integrated approach. The overall objectives are: the development and implementation of new, reliable, cost-effective technologies, tools and methods for sustainable water supply, use and discharge in the main water consuming industries in order to significantly reduce water use, mitigate environmental impact and produce and apply water qualities in accordance with industrial own specifications (fit - for - use) from all possible sources, and contributing to a far-going closure of the water cycle in a economical, sustainable and safe way while improving their product quality and process stability.

Key words:

Waste water recycling, reduce water use, water quality, sustainable water supply

Introduction

The global water crisis is emerging as one of the most serious natural resource issues facing the world today. Water is a high value resource and it is directly related to economy, health and safety aspects.

By consuming several billions m³ of water a year, industry has a significant impact on available water sources. Legislation, stringent discharge standards as well as process and product demands force industry to ensure higher water quality corresponding to increasing costs. For the water consuming industry, water is no longer regarded as a consumable or utility but as a highly valuable asset: a vital element used in close conjunction with the production processes. Industries want to become more independent of public and private parties for the supply of process water and the treatment of wastewater.

Costs for wastewater treatments range from 0.5 EUR/m³ to 2.5 EUR/m³. Any increase in the global price of water which could reach as high as 2.5 EUR/m³ by 2010, would increase these expenses from 1.0 EUR/m³ to 5.0 EUR/m³.

Due to increase of the prices of technical waters and waste water treatments and due to global scarcity of water, the recycling of waste water is becoming the necessity. Closure of the water cycle (called recycling) is important from economical and sustainable point of view, but it must be realized in a safe way while improving product quality and process stability at the same time (water quality for all processes should be of such quality to avoid any process and final product quality problems).

At present, technological bottlenecks limit the application of water loop closure. As a result of continuous water recycling, several groups of substances such as salts, organic micro pollutants, microorganisms, etc. are concentrated in the water loop and may cause water quality problems as well as health risks.

The textile finishing industry is the second biggest water consuming sector in Europe (after agriculture). Although literature data differs, it is evident that the most important water consuming processes inside textile industry are:

- a) washing and rinsing (up to 840 L/kg),
- b) dyeing (up to 300 L/kg) and
- c) finishing (up to 930 L/kg).

Textile finishing industry in a broad sense of world, including dyeing, printing and wet finishing, such as flame retardant finishing, durable press finishing and others, is beside being the biggest consumer of water inside the industrial sector also one of the main sources of emissions. One of characteristics of textile waste water is high oscillation of ecological parameters (COD from 150-12000 mg/L and BOD from 80-6000 mg/L). Beside dyes, the textile waste water can contain also surfactants, salts, heavy metals, fats, oils, many different organic and inorganic additives, finishing agents, even very toxic micro pollutants etc. Textile industry is known as a potential source of various micro toxic pollutants like persistent organic pollutants (POPs), phenols, formaldehyde forming compounds, various aromatic amines etc.

Several projects address water loop closure related issues but are linked to drinking water or municipal wastewater and not to industrial wastewater. The focus in these projects was on the application of membrane processes (including MBR) and advanced oxidation processes for the removal of organic (micro) pollutants. Although the application area is municipal wastewater, the technological developments will also be relevant for industrial applications. Also various technologies were developed and evaluated for application on industrial wastewater. Besides the earlier mentioned organic pollutants focus was at heavy metals, nitrates and salts.

In summary, various physicochemical and biological wastewater treatment technologies have been or are being tested either alone or in treatment trains to minimize the environmen-

tal impact of wastewaters in general or of specific target compounds in particular. However, most of them focus on advanced water treatment for discharge. A comprehensive approach for water loop closure in industry has not yet been proposed and a number of barriers on the road to real sustainable water use in industry have to be removed. The increase of global competition and thereby the need to increase cost-effectiveness and to increase product quality and new EC directives and related legislation are forcing further reduction of water use, environmental impact (WFD) and related energy consumption.

Besides the application of good environmental practices pursued by the Strategic Research Agendas of Water and Textile EU Platform, an optimal methodological solution for textile waste waters management has to be applied in order to minimize the discharge and produce an alternative water source at the same time. Strategic Research Agendas of Water and Textile EU Platform give directives for the research and for environmental care including new materials, processes and waste water treatment technologies. Special attention is given to the follow up of toxic compounds, coming into the waste water after the finishing process or after the waste water treatment. For all these reasons a lot of research has been done on textile waste water treatment, but till today not good solutions have been proposed, very often they are too expensive and not efficient enough regarding to frequent change of production. Although Europe has extensive knowledge and experience of developing solutions in the field of water, the fragmented character of the European water sector strongly limits its potential. A focused European approach on industrial water has enormous potential that, when properly managed, will foster technical innovations. Therefore four sectors, i.e. paper, chemistry, food and textile have joint their expertise by learning from each other inside the EU project from the FP7, named AquaFit4use. AquaFit4Use is considered by the European Commission as a flagship project in the area of industrial water technologies.

Participants

In the project AquaFit4use there are 35 participants from 14 EU countries. From Slovenia there are 4 participants: University of Maribor (Department of Textile Materials and Design, Laboratory for chemistry, dyes and polymers), Association of Textile Companies IRSPIN, Textile Company Textina and Textile company Svilanit. Participants are presented in the Table 1.

Goal of the Aquafit4use Project

As shown in the SRA of the WSSTP the four target industries, each with different know-how, deal in general with similar problems and challenges. Sectors that were involved in previous European and national; research projects developed knowledge that can be used in this project, not only for their own sector, but also in other sectors; industries can learn and share many practices from each other. Thus, cross-sectorial knowledge transfer is a very important element in AquaFit4Use. During the complete project period, but especially in the case studies, RTD and industrial partners from one sector will also be active in other sectors bringing over their experience in relation to sustainable water use. As paper industry has a long history in water re-use they will take the lead in this.

Sustainable water use in industry is the goal of AquaFit4Use, by a cross-sectorial, integrated approach. The overall objec-

Table1. Participants in the AquaFit4use FP7 EU project

No	Beneficiary name	Short name	Country
1	TNO, Coordinator	TNO	Netherlands
2	Papiertechnische Stiftung	PTS	Germany
3	Complutense University of Madrid	UCM	Spain
4	VITO	VITO	Belgium
5	CEIT	CEIT	Spain
6	Veolia	VEO	France
7	University of Maribor	UMB	Slovenia
8	ENEA	ENEA	Italy
10	Nestlé Water Management & Technology	NW	France
11	Perstorp	PSP	Sweden
12	DHI	DHI	Denmark
13	Cons. Hijos de M Sanchez Besarte	CHS	Spain
14	ATMSA	ATM	Spain
15	SAPPI	SAP	Netherlands
18	Unilever	ULR	Netherlands
19	Vermicon	VER	Germany
20	EnviroChemie	ENV	Poland
21	Wedeco	WED	Germany
22	MostforWater	MFW	Belgium
23	BASF	BASF	Belgium
24	Tekstina	TXT	Slovenia
25	Svilanit	SVT	Slovenia
26	Aquatest	AQT	Czech Republic
27	Alpro	ALP	Belgium
28	Smurfit-Kappa	SMK	Germany
29	Uniresearch	UNR	Netherlands
30	Holmen Paper Madrid S.L.	HOL	Spain
31	OBEM S.p.A.	OBEM	Italy
32	INOTEX spol. s.r.o.	INOTEX	Czech Republic
33	IRSPIN	IRSPIN	Slovenia
34	EUCETSA	EUCETSA	Belgium
35	PCCCell GmbH	PCC	Germany

tives are: the development and implementation of new, reliable, cost-effective technologies, tools and methods for sustainable water supply, use and discharge in the main water consuming industries in order to significantly reduce water use, mitigate environmental impact and produce and apply water qualities in accordance with industrial own specifications (fit - for - use) from all possible sources, and contributing to a far-going closure of the water cycle in a economical, sustainable and safe way while improving their product quality and process stability. The 4 pillars of the project are:

- Industrial Water Fit-for-use,
- Integrated water resource management,

- c) Strong industrial participation and
- d) Cross-sectorial technologies and approach.

Water fit-for-use is the basis for sustainable water use; the integrated approach a must. Tools will be developed to define and control water quality.

The heart of AquaFit4Use however is the development of new cross-sectorial technologies, with a focus at biofouling and scaling prevention, the treatment of saline streams, disinfection and the removal of specific substances. By intensive co-operation between the industries, the knowledge and the technologies developed in this project will be broadly transferred and implemented. This AquaFit4Use project is based on the work of the Working group 'Water in Industry' of the EU Water Platform WSSTP; 40 % of the project partners of AquaFit4Use were involved in this working group. The expected impacts of AquaFit4Use are: A substantial reduction of fresh water needs (20 to 60%) and effluent discharge of industries; integrating process technologies for further closing the water cycles; Improved process stability and product quality in the different sectors and strengthening the competitiveness of the European Water Industry.

The project is divided into 6 SP (sub programmes) and each SP still in several WPs (work packages). By tailor-made treatment technologies and concepts levels Sub

Presentation and goals of Sub Project Sp5 "Pilot Cases"

The sub project SP5 "Pilot cases in the four related target industries" aims on high water-reuse rates, including maximum reduction of energy and chemicals leading to more efficient use of limited resources in the sectors of paper, chemistry, food and textile and is coordinated by PTS in cooperation with 28 partners from 11 European countries. SP5 is a crucial part of the EU-project AquaFit4use integrated in the 7th Framework Programme on Research and Technology Development of the European Commission.

Within SP5, 20 industrial partners (12 water users, 6 technology suppliers, 2 federations) in collaboration with 8 RTD partners (6 institutes and 2 universities) have joined forces for tackling innovative cost & energy effective water treatment measures. The overall goal is to develop new management systems including new approaches, tools, methods, and technologies needs focusing at cross-sectorial issues that concern the major water consuming industries in Europe. SP5's project period covers 1st June 2008 - 31st May 2012.

Goal of Sub Project SP5 "Pilot cases in the four target industries" is to lay the basis with the highest water consumption narrowing water circuits (less effluent discharge to the environment) in four related sectors. By maximum reduction of concentration levels, the pilots aim on high water-reuse rates including maximum reduction of energy and chemicals leading to more efficient use of limited resources. In this context appropriate data bases will be elaborated from which we deduct tailor-made integrated water treatment concepts and energy design covering best combination of advanced, cost-effective and cross sectorial clean water technologies. Standardisation is very important and effective data measuring and monitoring of critical compounds is essential for all four sectors.

Performance of Sub Project Sp5 "Pilot Cases"

For facing such challenging goals within Sub-Project SP5, 20 industrial partners representing water users (paper: Smurfit Kappa, Holmen, Sappi; chemistry: BASF, Perstorp; food: Unilever, Nestle water, Alpro; textile: Textina, Svilanit, Inotex), water technology suppliers (Veolia, EnviroChemie, Wedeco, Vermicon, Mostforwater, Obem, Logisticon) and federations (Eucetsa, ISPRIN) have joined forces with 8 RTD partners, i.e. 6 institutes (PTS as SP5-coordinator, VITO, CEIT, TNO, ENEA, DHI) and 2 universities (UCM, UMB).

The study through pilot cases covered by the four sectors, i.e. Work packages WP5.1 (paper), WP5.2 (chemistry), WP5.3 (food), WP5.4 (textile) is needed to evaluate the economical and technical feasibility of water treatment methods as well as for improving systematic exchange of information from case studies. The collaboration between R&D agents, paper/chemistry/food/textile processors and regulatory agencies will facilitate the process of implementation of water reuse practices in the different sectors.

SP5's pilot cases will be carried out in model companies of the paper, chemical, food and textile sector. Tailor-made treatment concepts will be pinpointed based on the already available and new elaborated knowledge in the four sectors.

By investigating pilot cases in four different sectors complementary knowledge will be elaborated to draw guidelines for the quality of reused water as the crucial basis for improving process stability and product quality leading to increased competitiveness and protection of the environment. Only a holistic approach of integrated and combined treatment units covering all relevant water issues will meet product quality and process stability demands and finally will ensure competitiveness of the focused big water users as well as corresponding suppliers.

By learning from each other knowledge existing in one sector will be transferred to other sectors and synergisms in overcoming comparable problems will be ready for use. Especially combined reliable and cost-effective clean water technologies will be focused for solving similar problems in related sectors. As a result a unique data base - based on pilot cases - will be established serving the basis for gaining knowledge about possible maximum reduction of water use and corresponding energy and chemical consumption.

Work Package 5.4

Work package 5.4 (WP5.4) entitled Textile sector represents one among four work packages within sub project SP5 - Pilot cases in four sectors and describe activities related to the textile sector and associated participants; Slovene textile companies Svilanit and Tekstina, Slovene textile association Irspin and textile company Inotex from Czech republic. The leader of this work package is University of Maribor, Faculty of Mechanical Engineering in close cooperation with an Italian research institute ENEA.

As well as in other industrial sectors in textile sector all partner activities are in line with the main goals of the project - the use of innovative and cost effective water treatment technologies which provide the right water quality for reuse considering individual sector (paper, food, chemistry, textile). As a result the use of fresh water needs will be significantly reduced as well

as the production of wastewater quantity. By this approach cross-sectorial cooperation and strong collaboration with industrial partners as well as exchange of knowledge, expertise and cleaning technologies are very important issues. Several innovative wastewater or process water cleaning technologies will be evaluated on laboratory scale and the most promise ones will be implemented as pilots.



Figure 1. Participants of Kick-off meeting in Delft.



Figure 2. Technical meeting of SP5 group.

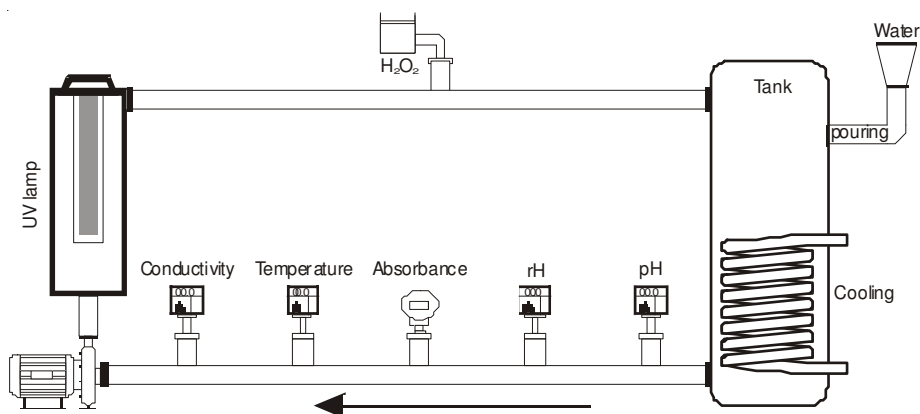


Figure 3. Schematic representation of the UV/H₂O₂ laboratory scale reactor.



Figure 4. Photo of the UV/H₂O₂ laboratory scale reactor for textile waste water decolouration.



Figure 5. Photo of the 50 litre pilot plant.

Acknowledgement

This proposal is prepared by the thematic working group of the Water Supply and Sanitation Technology Platform (WSSTP), one of the EU Technology Platforms. Over 40% of all project partners of AquaFit4Use were involved in this Thematic Working group and have formed a European network on this issue since 2004. The integrated research project AquaFit4use (EU-FP7-ENV-211534) is being funded by the European Commission covering six Sub-Projects.

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