

WATER RECYCLING AND REUSE IN EU: NECESSITY AND PERSPECTIVES FOR ESTABLISHING EU LEGISLATION

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Abstract

European countries depend on appropriately treated wastewater to protect the environment and ensure that freshwater is available for all applications. Water recycling and reuse through surface and groundwater bodies is a common practice and public health is protected through potable water standards. The reuse of water for non potable applications or potable substitution has been proven internationally to be a drought proof source of water and one of the most effective water scarcity solutions in water stressed regions. This paper considers: (a) the status of water recycling and reuse in EU countries, (b) the major challenges, (c) the future views, including the necessity of establishing regulations of wastewater recycling and reuse in Europe.

Introduction

Europeans have a long history in water reuse. Examples of rainwater reuse exist since the Minoan time, *ca.* 3,000–1,100 B.C. Also, wastewater reuse was practiced in several regions during the Ancient Greek and Roman civilizations (Antoniou and Angelakis, 2011). Land application of wastewater is an old and common practice, which has gone through different development stages with time, knowledge of the processes, treatment technology, and evolution of relevant regulations (Angelakis *et al.*, 2005). Wastewater has also been used in the Mediterranean civilizations, for example in the 14th and 15th centuries in the Milanese Marcites and in the Valencia huerta, as well as in the North European, like in Great Britain, Germany, France, and Poland.

Among EU countries, most of the northern ones traditionally have abundant water resources, stringent environmental standards and higher water prices. Until the drought of 2003, 2005 and 2006, the need for additional water supply through the reuse of treated wastewater was not always seen as a priority, although the protection of the receiving environment has been considered important. However, many large cities, such as London and other conurbations in large river basins, mainly depend on recharging the surface and ground water bodies by treated wastewater. Thus, during dry weather conditions 70% of the

water supply in London and Berlin is treated wastewater, enabling London to operate with a water availability of 265m³/inh.yr (Planet Water, 2003). Unplanned wastewater recycling and reuse is a common practice in all over the world, meaning that treated wastewater is a reliable water resource.

Water reuse or recycling is of vital importance to EU countries, because it: (a) increases the available water resources, (b) reduces eutrophication, and (c) can reduce cost and energy demand (subject to application). Water reuse is a water scarcity solution and the aforementioned issues are some of the most significant drivers in the Water Framework Directive (WFD) (EU, 2000). Perhaps the problem is that, water reuse is one of the misunderstood water applications.

On the other hand, water is usually taken for granted until the tap is dry. The dry winter of 2004, the dry spring and summer of 2005 highlight the dramatic impact of drought and the need for a European Drought management strategy. The impact of drought can be greatly exacerbated by the inefficient use of water, inadequacies in infrastructure, water use, demand management and in legislative frameworks and regulatory mechanisms. The economic impact of droughts has been approximately estimated to 25 billion € over the last 30 years and was nearly 12 billion € in 2003. Research has shown that the worst drought in USA was more than twice the cost of the worst flood (EURAQUA, 2004).

Water stress is also increasing due to population density, diffused pollution and short-term seasonal population increases due to tourism and increased demand for irrigation to improve agricultural productivity. At the same time, the WFD requests an analysis of water use, which in some regions or basins could lead to a reduction of 15 to 20% of abstraction licenses, in order to protect surface and groundwater quality and quantity. The need for alternative sources of water was emphasized by the 2003 drought which resulted to a 30% reduction in agricultural production. This drought was a dramatic example of the measured 20% reduction in annual precipitation from 1900 to 2000 (Angelakis and Durham, 2008).

Water Recycling and Reuse Status in Europe

Although treated wastewater has been an important means of augmenting river flows in Europe and the subsequent use of such water for a range of purposes constitutes indirect reuse of wastewater, it is becoming increasingly attractive to use reclaimed or treated wastewater more directly. In addition, water reuse is attractive in terms of sustainability since wastewater requires disposal if it is not to be recycled. There are several cities in northern Europe that rely on indirect

potable reuse for 70% of their potable resource during dry summer conditions (Angelakis and Durham, 2008).

The AQUAREC (2006) project has identified over 200 water reuse projects in Europe out of 3,300 water recycling projects globally (Bixio *et al.* 2005). It is estimated that 700 Mm³/yr of water was reused in Europe in 2004, which is less than 20% of the estimated potential for water reuse. The AQUAREC (2006) project developed a model-based approach which is able to quantitatively assess the potential for reuse of wastewater effluents. The approach was applied to quantify the EU water reuse potential and compared well to existing estimates.

Spain shows by far the highest water reuse potential (projections in 2025), the calculations suggesting a value of over 1,300Mm³/yr. Also, all Mediterranean countries exhibit estimated high reuse potentials of 550Mm³/yr (Italy) and 120 Mm³/yr (France). Wastewater reuse appraisals for Germany amount to 150Mm³/yr, whereas Portugal and Greece account for reuse potentials of less than 60Mm³/yr. Hochstrat *et al.* (2005) reported similar estimations. Overall, the estimates suggest a treated wastewater reuse potential of 2,455Mm³/yr for EU. It accounts 2% of irrigation water used in European countries, which is over 60% of total water use (Angelakis and Durham, 2008). However, considering only the seven Mediterranean countries (including Portugal) their reuse potential of 2150 Mm³/yr accounts for 3.5 % of the irrigation water used in these countries. Thus, in Southern Europe, planned water reuse is still a limited, but rapidly growing source of irrigation water. All of EU-Mediterranean States (with exception Malta), have recently established new regulations or they have revised the existing before (Salgot *et al.*, 2011).

Today recycled wastewater should be considered as a reliable, valuable, drought proof source of water that must be taken into account in formulating a sustainable water policy. Thus, by establishing regulations and/or guidelines and best practices planning and implementation of water reuse projects in all EU countries will be encouraged and the differentiation of the regulations established among states under similar climate, agronomical, social and economic conditions will be eliminated.

The Future of Water Recycling and Reuse in EU

The future of water reuse in EU could be summarized as follows:

- The need for water reuse and the benefits are comprehensively recognized as a normal water resource management practice and not just as a water scarcity solution.

- EU has in place the regulatory and institutional framework tailored to suit local needs to take advantage of the water recycling and reuses opportunities to safely maximize water efficiency. Water quality guidelines and best practices should be attached to the UWWTD (EU, 1991).
- New projects are being implemented using the guidelines and knowledge and experience from ongoing ones.
- The benefits of soil aquifer treatment (SAT) are accepted as a sustainable advanced wastewater treatment process, that can play an important role in a multi-barrier indirect reuse system, as demonstrated on three US projects which show that the groundwater recharged with reclaimed water is of potable quality due to the SAT (Amy *et al.*, 2005).
- Project viability is based on clearly measurable environmental, social and economic benefits using whole life, sustainability and cost effectiveness tools that provide a fair way of evaluating the benefits. The EU WaterStrategyMan research project (Arid Cluster, 2005) has developed a manual for “valuing water in water shed in the absence of market prices: guidance for WFD Implementation
- Projects are taking advantage of financial incentives available to build skills and confidence in each country.
- Innovative projects are encouraged to promote cohesion, international leadership and export opportunities.
- The EU is implementing water recycling and reuse projects with EU technology and expertise, which satisfy export opportunities in developed and developing countries based on the credibility in our home markets.

Conclusions

The southern EU countries with reduced availability of water resources have been greatly benefited by the additional resources, such as treated wastewater. This brings significant advantages to agriculture (e.g. crop irrigation), industry (e.g. cooling water) and tourism (e.g. wetlands, landscape and golf course irrigation) and through increases in water availability. Therefore, considering its various potential benefits (protection of water resources, prevention of coastal pollution, recovery of nutrients for agriculture, augmentation of river-flow, savings in wastewater treatment, groundwater recharge, source for industry and sustainability of water resource management, etc.), wastewater recycling and reuse can be applied to the advantage of both northern and southern EU countries. The importance of wastewater recycling and reuse has been clearly

prioritised in the Integrated Pollution Prevention Control legislation (IPPC) for industry, as described in the best available techniques (IPPC <http://eippcb.jrc.es>).

However, so far, no regulation, quality regulations and/or guidelines or good practice of wastewater recycling and reuse exist at the European level. Reference to water reuse is made in the article 12 of the European Wastewater Directive (91/271/EC), stating: "*Treated wastewater shall be reused whenever appropriate*". In order to make this statement reality, common definitions of what is "appropriate" are needed. In order to take advantage of its full potential in a planned and sustainable way, EU should be involved in setting-up effluent quality criteria and good practices related to wastewater recycling and reuse. Such criteria will contribute to improve management of water resources and to ensure protection of public health and environment in a sustainable way. This would also support IPPC legislation, which is included in the legislation covered by the Water Framework Directive (WFD 2000/60/EC). Recycled wastewater is a reliable, valuable, drought-proof source of water, that must be taken into account in formulating a sustainable water policy. There is a need to encourage planned and appropriate wastewater recycling and reuse in all EU countries by establishing regulations and/or guidelines and best practices.

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