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Present situation of wastewater treatment in the Iranian industrial estates: Recycle and reuse as a solution for achieving goals of eco-industrial parks

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ABSTRACT

Iran is located in arid and semi-arid region, which means water resource management is a strategic issue for this country. Water scarcity is one of the most critical concerns of industrial estates in Iran. For this reason, recycling and reusing of treated wastewater is the most practical solution for compensating of water shortage in industrial estates. Currently, only 20% of total treated wastewater is used for irrigation and almost 0.81% is consumed for industrial purpose. This study presents an overview on the wastewater management at the Iranian industrial estates for the purpose of achieving the goal of eco-industrial parks by describing the present situation and discussing the experiences of wastewater reuse systems for irrigation and industrial purposes. The aims of this study was to provide an overview of the wastewater management at the industrial estates in Iran towards achieving eco-industrial parks by describing present states and the outcome of wastewater consumption for irrigation and industrial purposes.

1. Introduction

During the past century, while the world population has been tripled, the water consumption has increased sixfold which irrigation accounts for 70% of global water withdrawals, industry for 20%, and municipal use for 10% (Gourbesville, 2008). Today, a significant volume of wastewater enters directly into water bodies with poor quality because of insufficient infrastructure (treatment plants) or improper operating wastewater treatment facilities (Bazza, 2002; Kamizoulis et al., 2010). Globally, two million tonnes of wastewater is discharged into the world's waterways and about 90% of all wastewater in developing countries is discharged untreated directly into rivers, lakes or the oceans (Corcoran et al., 2010). In developed countries, industry is the biggest consumer of water and accounts for 50–80% of total water demand. This is far more than 10–30% in developing countries where agriculture is the largest consumer (Kretschmer et al., 2002). Industrial wastewater effluents cause both human health and environmental disasters due to highly toxic pollution including complex organic compounds and heavy metals (Mohsen and Jaber, 2003).

From 1945 until now, the development of industrial estates has been introduced in many countries as an economic development strategy. Easy organizing and planning for factories, easy controlling of pollutants and reduction of wastes are of the main advantages for establishment of industrial estates. However, applying more strict regulations of standard agencies and carefully monitoring by environmental NGOs have increased the costs of industrials wastewater treatment. Therefore, industrial estates have forced to take different environmental approaches during the past decades which are summarized in Fig. 1 (Campiglio et al., 1994; Elabras Veiga and Magrini, 2009; Hartwick and Olewiler, 1998; Ield, 2001; Neher, 1990; Tietenberg and Lewis, 2008; UN, 1992a, 2011, 2012; UN-Water, 2012). The theory of recycling and reusing of the industrial wastewater was developed in 1980 as a major economical–environmental factor in water resource management and was practiced according to Rio conference in 1992 (Campiglio et al., 1994; UN, 1992a, 1992b). According to Rio+20 conference in 2012, the concept of reused industrial wastewater, which is produced in eco-industrial park must be introduced as a clean product towards achieving millennium goals and green economy aims (Elabras Veiga and Magrini, 2009; UN, 2011, 2012; UN-Water, 2012).

The wastewater can be considered as a new water resource in an eco-industrial park by shifting the basis of industrial wastewater from a linear to a closed loop system (Gibbs and Deutz,

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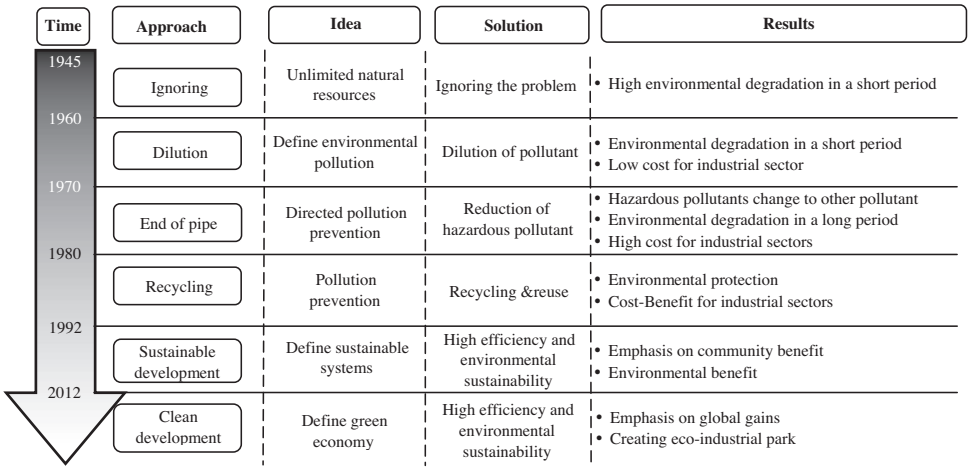

Fig. 1. Summary of the main approaches has been taken during the past decades for industrial wastewater by industrials estates.

2005). This closed loop systems can be obtained by installing proper wastewater treatment plant (WWTP) which is proposed by several researches and summarized in Fig. 2 (Adewumi et al., 2010; Asano, 2001; Asano et al., 2002; Bakopoulou et al., 2011; Davis and Hirji, 2003; Gumbo et al., 2003; Visvanathan and Asano, 2009). The first closed loop system includes primary and secondary treatment units that is treating wastewater for meeting the standards and successes to improve the quality of wastewater for consumers who do not need high quality water. In developing countries, this system is acceptable for achieving eco-industrial park in a short time. Advanced treatment units (ATU) are necessary in order to completely treat the wastewater as a new water resource instead of fresh water.

Various methods have been practiced for treating industrial wastewater and providing reusable water. This includes membrane technologies such as: micro-filter, ultra-filter, nano-filter and reverse osmosis (Barredo-Damas et al., 2010; Borsi et al., 2012; Braeken et al., 2004; Fersi and Dhahbi, 2008; Kim et al., 2005; Nandy et al., 2007), chemicals and photo-chemicals processes (Erdogan et al., 2004; Rodrigues et al., 2008), biological treatment units (Badani et al., 2005) and integrated systems (De Nardi et al., 2011; Hoinkis and Panten, 2008; Souilah et al., 2004; Sarkar et al., 2006; Zhang et al., 2011).

However, a few researches were published about the performance result of ATUs for treating wastewater of industrial estates for reusing purposes at the arid and semi-arid regions. For

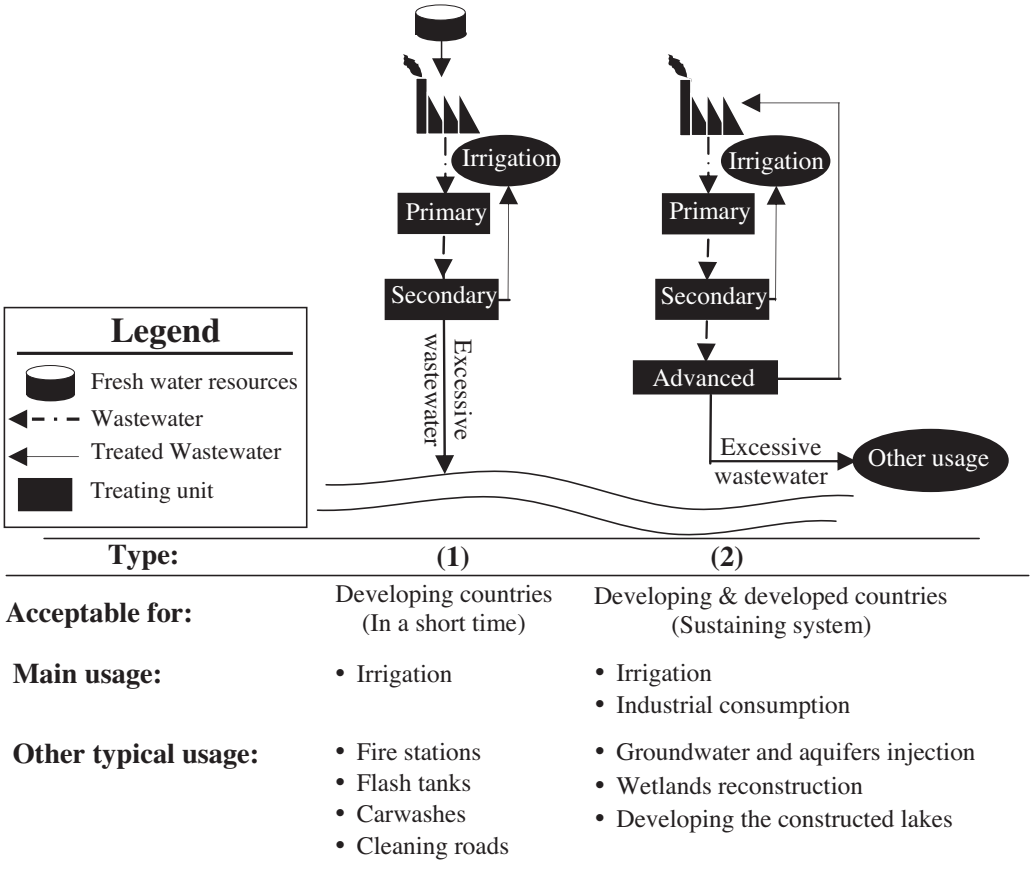

Fig. 2. The summary of proposed flow-diagram of closed loop systems for achieving eco-industrial park.

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