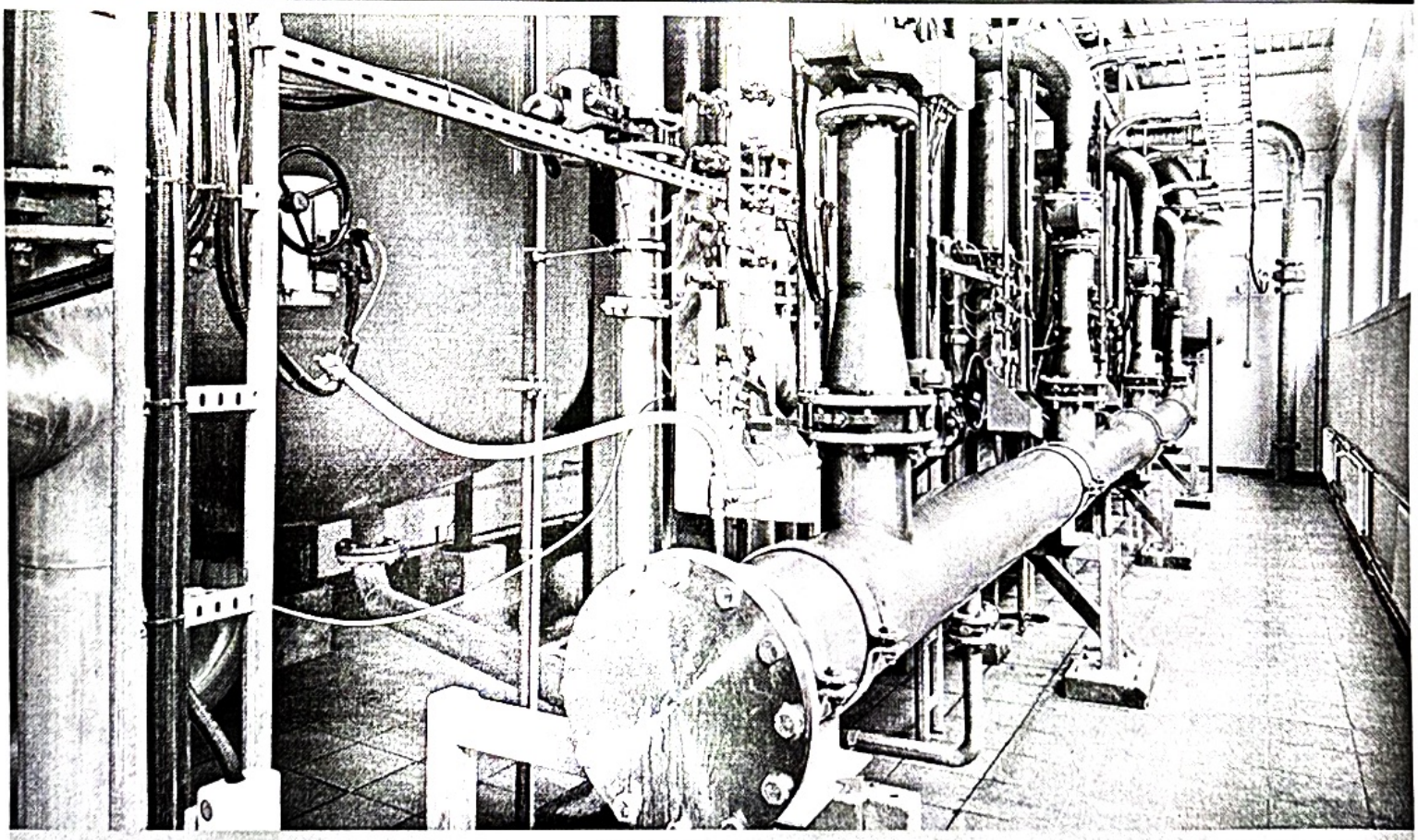
Resource Recovery in INDUSTRIAL WASTE WATERS



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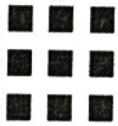

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24

Recovering industrial wastewater: application of electrodialysis reversal approach

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Abbreviations

AM	anion-selective membrane
BOD	biological oxygen demand
Ca^{2+}	calcium ions
CM	cation-selective membrane
COD	chemical oxygen demand
DC	direct current
ED	electrodialysis
EDR	electrodialysis reversal
gpd	gallon per day
MF	microfiltration
mg/L	microgram per liter
Mg^{2+}	magnesium ions
mgd	million gallons per day
min	minute
NF	nanofiltration
RO	reverse osmosis
SDG	sustainable development goal
UF	ultrafiltration
μm	micrometer

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24.1 Introduction

Water is a major contributing factor to the development of a country: it is necessary for the production and preservation of a host of benefits and services for people and ecosystems. But hasty industrialization on urbanization has increased very sharply and led to the generation of large amounts of wastewater worldwide. Half of the freshwater is used in agricultural activities worldwide, while the remaining half is discharged into the surrounding as wastewater generated from industry and household activities thus causing serious effects on aquatic life, human health, and economic productivity (Smol et al., 2020; Voulvoulis, 2018). In developed countries like North America and Europe, the rate of water consumption at the industrial level is higher as compared to developing nations, that is, 50% and 4%–12%, respectively.

The waste from water can be reduced in three different ways including regeneration, reuse, and recycling. During the reuse process, wastewater can be converted into usable form, while in the regeneration process, pollutants are removed by some treatment. In the regeneration recycling process, the contaminated water is often regenerated to separate pollutants to recycle it.

24.1.1 Background

In recent years, the increase in the utilization of natural resources and increase in mining activities lead to an increase in the frequency of metals discharge into the environment. Therefore, the management of wastewater discharged from industries becomes an important concern all over the world. Several studies and research have been presented so far to treat wastewater using different processes (Abbas et al., 2016; Rajasulochana and Preethy, 2016; Azimi et al., 2017; Alalwan et al., 2020; Babincev et al., 2020; Mustafa and Asmatulu, 2020). The World Economic Forum classified water shortage and its effects as the major environmental risk at the world level (World Economic Forum, 2014). Distinguishing the growing challenge of water shortage, wastewater management has also found recognition in one of the 17 Sustainable Development Goals, namely, SDG 6, which aims to, among others, substantially increase water use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater by 2030 (Masi et al., 2018; UN General assembly, 2015).

24.1.2 Types of different wastes in industrial wastewater

The contamination level of industrial wastewater depends upon the level of technical processing in each industry sector and can be reduced steadily with the upgradation of industrial technologies. The aggregate rate of industrial wastewater is higher in developing countries as compared to developed ones.

The type of wastewater effluent from different industries is listed in the table given below (Table 24–1). As the characteristic features of each type of wastewater are different, the treatment of industrial wastewater should be drawn particularly for the specific type of