

Chapter 2

Characteristics of the Hydrophytes

Method

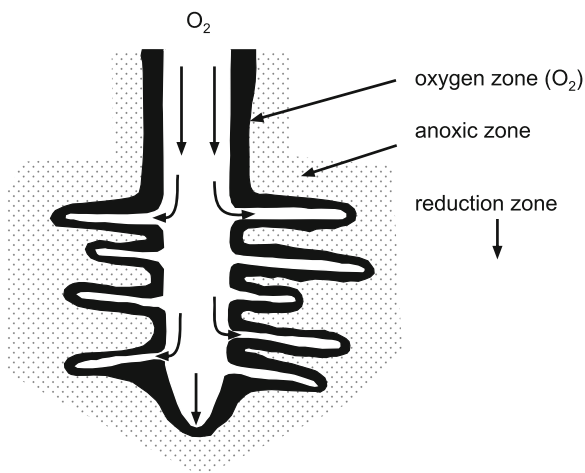
Hydrophyte wastewater treatment plants are designed on the basis of the systems known as “treatment wetland”, introduced in western and North Europe, North America and Australia. These systems simulate aquatic and habitat conditions of natural marsh ecosystems. The term “wetland” refers to the areas where the water level is higher than the ground level for most of the year, which results in soil saturation with water, and causes the growth of characteristic plants species. The hydrophyte method of wastewater treatment is a biological process which proceeds in the presence of various microorganisms, and aquatic and hydrophytes plants grown in specially designed soil filters or ponds. Due to specific conditions enabling the development of hydrophytes, the intensification of alternative oxidation and reduction processes, accompanied with sorption, sedimentation and assimilation processes removing the majority of pollutants from wastewater, can be observed.

Initially, there was some difficulty with accepting the term “wetland”, that is why several terms describing water treatment plants were used e.g. hydro-botanic plant, soil-plant, hydrophytes plant, macrophytes plant, reed plant, marsh plant, root plant and others. Thus, it seemed necessary to choose one of the terms or introduce a new one. Taking into account the basic role of hydrophytes in the treatment process, the selected name for that process is “treatment wetland systems” (or treatment plants).

Plants most often used in such types of systems are reed (*Phragmites australis*) and willow (*Salix viminalis*). Reed is used because of its extended system of rhizomes and roots. The stalks and leaves of reed contain an extended porous and gaseous tissue called aerenchyma. Oxygen from the atmosphere goes through that tissue to the underground parts of the plants, where aerobic micro-zones (with O_2) around roots and rhizomes are created (Fig. 2.1). Those micro-zones are surrounded by anaerobic micro zones (without O_2 , however, in the presence of NO_3^-). Outside them there are anoxic micro-zones (without both O_2 and NO_3^-). This results in forming conditions which allow the development of heterotrophic microorganisms taking part in a biochemical transformation of supplied pollutants. Reed is also resistant to frost and extensive summer heat.

Willow is a hydrophyte plant which is often used because of its fast growth related to the intense consumption of biogenic compounds. Hydrophytes plants do not

Fig. 2.1 Redox conditions around rhizomes of hydrophytes (Obarska-Pempkowiak et al. 2010)



transport oxygen to the ground. They grow in the environment of marsh ecosystems. To construct the treatment system for wastewater, the properties of these plants must be taken into account, and conditions for oxygen diffusion must be created.

The main advantages of treatment wetland systems are: simple maintenance, robustness to irregular inflow of wastewater, and lower cost of maintenance in comparison with conventional treatment systems. Moreover, their natural appearance better suits the natural environment. Treatment wetland systems, contrary to traditional biological plants, do not produce secondary sewage sediments and allow the simultaneous removal of biogenic compounds of nitrogen and phosphorus as well as the removal of specific pollutants, for example heavy metals. The main disadvantages of these systems are the following. They need a lot of area, and it takes up to 2–3 years to fully develop the rhizosphere of the plants. Treatment wetland systems are in use mostly in rural areas as well as in urbanized areas with dispersed habitats development, where conventional sewer systems and a central conventional WWTP are avoided because of high costs.

Up till now treatment wetland systems have been used:

1. for removal pollutants from point sources such as domestic wastewater, industrial sewage and landfill leachate,
2. as buffer plant zones for the removal of pollutants from surface runoff,
3. as specially constructed systems for the dewatering and stabilization of sewage sediments.

Reference

Obarska-Pempkowiak H, Gajewska M, Wojciechowska E (2010) Hydrofitowe oczyszczanie wód i ścieków. In: Obarska-Pempkowiak H (ed) Warszawa: Wydawnictwo Naukowe PWN, Poland (in Polish), 307 pp

Treatment Wetlands for Environmental Pollution Control

Obarska-Pempkowiak, H.; Gajewska, M.; Wojciechowska, E.; Pempkowiak, J.

2015, XIII, 169 p. 60 illus., 8 illus. in color., Hardcover

ISBN: 978-3-319-13793-3