Components of a Phytodepuration system

Hydrophyte and depurative systems in use

Phytodepuration treatments depend exclusively on their own components and don't need any input from outside electric energy sources.

Dominant vegetal organisms in wet environments are aquatic macrophytes and algae. They are organisms that complete their life cycles in aquatic or ground environments, periodically or perennially submerged, or saturated in water. In Phytodepuration systems, one or other is used depending on the technology adopted - macrophytes in sub-surface flow systems and floating hydrophyte basins, as well as algae in free surface systems.

Although belonging to different genus and families, macrophytes, based on their life form and development **habitat**, are usually divided into helophytes and hydrophytes. Helophytes include emergent rooted aquatic macrophytes: they are plants suited to life in environments where the ground can be saturated by water (fig.1).

Hydrophytes are floating or submerged aquatic macrophytes.

Emergent hydrophytes

Emergent hydrophytes have well developed rhizomes so as to take root firmly to the ground and assimilate nutritive substances. The stem has a strong base that becomes flexible and elastic towards the top. The leaves are thin and thread-like, but their tissue type (parenchyma aeriferous) compensates any apparently limited aeration. In fact, the stem is full of air holes that represent between 50-70% of the volume of the whole plant.

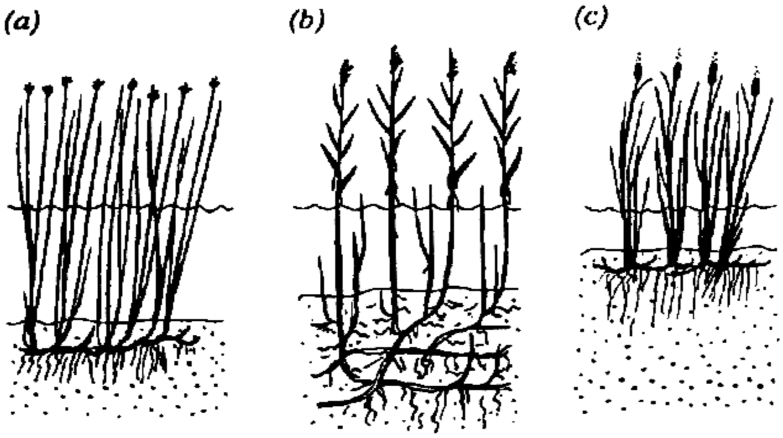


Fig. 1: Three different types of helophytes: a) Schoenoplectus lacustris, b) Phragmites australis, c) Typha latifolia

The most commonly used species in Phytodepuration systems are Phragmites Australis (Swamp Reed), Typha latifolia (Cattail), Iris pseudacorus (aquatic Lily) and Schoenoplectus lacustris (Swamp Rush).

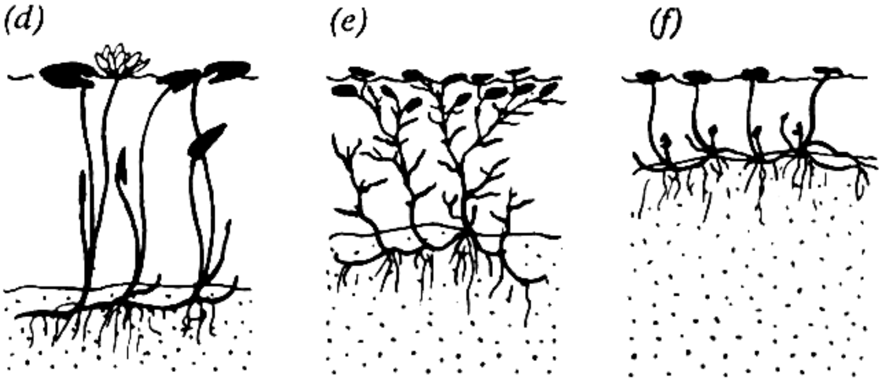
The Phragmites australis is an annual species. The part underground survives during the winter while the aerial part degenerates. It is widespread and common throughout Italy. The optimal temperature for vegetation growth is between 12°C and 23°C. The strengths, from the point of view of using Phytodepuration, are different:

- good extension of the underground perennial rhizomatous system, able to reach depths of 60-100 cms;
- it is one of the most competitive species in wetland environments, with a vast ecological spectrum;
- it survives in extreme temperatures (up to 5°C below zero);
- it is not subject to predation by mice or water rats;
- like other aquatic species, it helps develop the parenchyma aeriferous;
- rapid reproduction via vegetation.

Floating hydrophyte

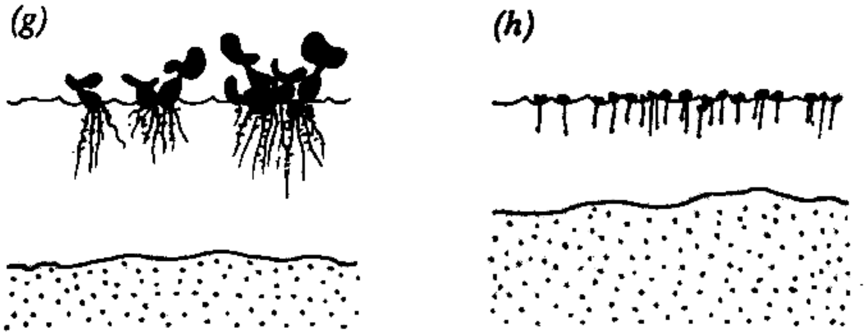
Floating hydrophytes' most obvious characteristics are floating leaves and airborne reproductive organs and can be of two types: rooted to the substratum (fig.2) or floating freely (fig.3); basins where they grow vary in depth between 25 and 350 cms.

Fig. 2: Three examples of emergent rooted hydrophytes: d) *Nymphaea alba*, e) *Potamogetum gramineus*, f)



Hydrocotyle vulgaris

Fig. 3: two examples of non-rooted floating hydrophyte: g) Eichornia crassipes, h) Lemna minor



They can also able be rhizomatous/cormose (with floating leaves on long, flexible stems), or stoloniferous (with climbing stems that go up into the column of water and support floating leaves on relatively short stems).

Floating hydrophytes mainly live freely in sheltered areas of bodies of stagnant or slow moving waters.

Among the most used species are Nymphaea alba (white water lily), Trapa natans (water chestnut), Eichhornia crassipes (water hyacinth), Hydrocotyle vulgaris (aquatic Soldinella), and Lemna minor (duckweed).

Floating hydrophytes are able to create thick surface coverage, thus almost totally reducing sunlight penetration, into the deepest layers of the water basin, as well as the transfer of gases between the water surface and the atmosphere. These hydrophytes frequently cause the disappearance of algae and establish anaerobic conditions within the column of water. Part of the photo-synthetically produced oxygen is transferred towards the roots and then the water, creating aerobic and anoxic areas where sequential reactions of nitrification and de-nitrification are favoured.

Submerged hydrophyte

Submerged hydrophytes' leaves are entirely submerged and complete their life cycles in clear water basins (necessary for their growth, as their photo-synthetic tissues are entirely submerged), up to 10-11 m deep.

Unlike terrestrial **habitat** plants and micro-algae, submerged hydrophytes synthesize carbon and nutrients by assuming them directly from the column of water. Submerged hydrophytes breathe at night, that is they use oxygen that has to be directly available in the column of water.

The most common species include the Elodea canadensis (water plague), Hydrilla and Lagarosiphon, Isoetes and Vallisneria.