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A MODULAR SEWAGE WATER TREATMENT SYSTEM FOR MEDITERRANEAN COASTAL CITIES

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There is general agreement that the treatment of sewage water in the mediterranean area requires the immediate attention of all people responsible for water treatment in communities and companies in countries such as Italy, France, Spain, Turkey, Greece, Yugoslavia, and the North African nations. At first glance, it appears that no special efforts are needed to install efficient sewage treatment plants in these countries, and the matter is just one of immediate action and availability of money to build suitable plants. A closer look shows, however, that along the coastal area of the Mediterranean Sea, water treatment plants with special features are needed that offer the possibility of operating in different modes which is very important in areas with high tourism. Most regions around the Mediterranean Sea face the problem of small sewage water loads in the winter and outstandingly high loads in the summer. Even large differences between working days and weekends can be measured. Plants designed and built in the way this project suggests offer a simple solution to most problems in the mediterranean countries by using modern measurement and control systems and load-dependent operation modes. Its modular structure permits operation of only parts of the plant in the winter and the entire plant in the summer.

Typically, there is no or only an insufficient sewage system available in the mediterranean regions (SBMC/EEC, 1990). This means that the sewage system has to be built parallel to the construction of the sewage water treatment plant. Due to tourism in the summer, the building of the sewage system and the treatment plant has to take place mostly in the winter. The entire construction requires careful timing. This is usually connected with problems that can only be overcome by modular systems that can be built much in advance of the winter period. Financial problems might also occur due to the size of the projects involved. These problems can be reduced by building the entire sewage plant in steps. The modular construction of such plants suggested in this project represents an effective solution to the sewage water problems in the mediterranean region. This means that the plant can be small at the beginning and grow with the growth of the sewage system. This measure helps to keep the initial costs low and to spread further costs over a longer duration.

The second measure for a successful sewage supply and treatment system is to reduce the cost of the sewage system by reducing its initial size as much as possible. If one looks at the structure of the communities in the mediterranean coastal area, one notices that most cities consist of a centre with many houses, hotels, and restaurants in addition to hotels, vacation facilities and/or marinas which are located away from the centre of the city. To avoid long and expensive sewage pipes from these facilities to the main sewage system, those facilities that are far from the centre should be supplied with individual, decentralized compact sewage plants which are inexpensive and adaptable to the special needs of such hotels and vacation facilities (Figure 1).

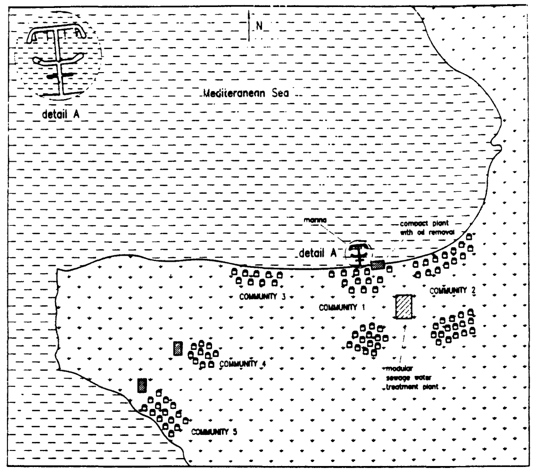

Figure 1. Typical mediterranean coastal community.

For these reasons, it is also necessary to have a special receiving station to accept sewage water and sludge originating from the collecting tanks usually used in households to store sanitary wastes and from the decentralized compact sewage plants. This sewage water is collected and delivered by lorries to the sewage treatment plant. It needs special handling before it is added to the sewage plant because of the already on-going biological processes and their higher concentration.

The concept we like to present is to build a main sewage treatment plant which grows with the sewage system and the needs of the main city. This plant will be modular and adaptable to winter and summer conditions. Only highly modern water treatment equipment combined with intelligent control systems will be used to obtain a minimum energy consumption (Bischof and Höfken 1991a, b) and provide simple operation of the plant. The modular construction will allow the same sewage plant to be installed in other villages and cities. Only the extension of modules will be different between the various plants. This will permit exchange of information between the various communities on the performance of the treatment systems and hence, will facilitate the running of the sewage treatment plants in the entire mediterranean region. The central plants will be supported by compact sewage treatment facilities in hotels and vacation facilities that can be widely spread throughout the countryside to avoid a long, widespread sewage system which is very expensive. The purified water coming out of the compact plants can go directly to the receiving waters; the sludge can be handled together with the faecal sludge originating from households of the surrounding areas in the central plant.

The following advantages of the system and of the concept are expected:

* variable operation modes
* low energy demand
* high purification power
* possibility of handling additional faecal sludge
* simple operation
* simple possibilities for enlargement
* low operation costs
* possibility to transfer the system to other mediterranean regions.

The following schematic representations show one of the main advantages of the system: the modular concept. Fig. 2 shows a first economic design capacity which is suitable for example for approximately 10,000 population equivalents according to the German guidelines which assume a sewage water temperature of 10°C and a sewage water load of 200 litre/population equivalents per day. This also implies

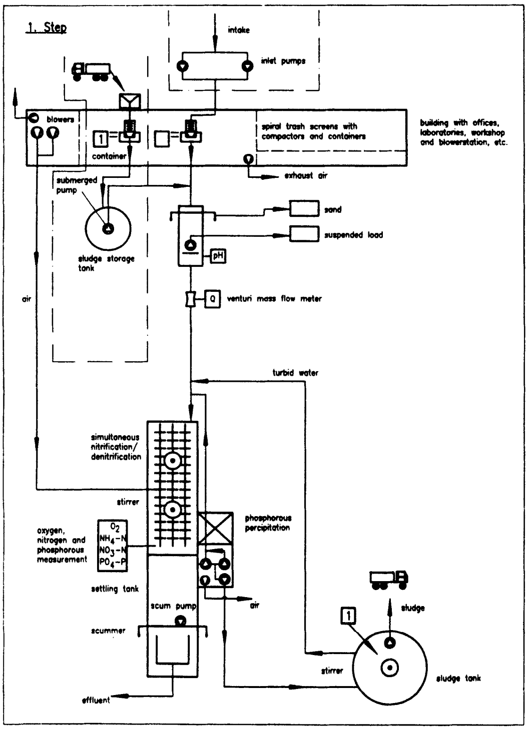

Figure 2. First design capacity.

that for each design capacity there is a large reserve because the average temperatures are higher and the sewage water load per heads and day are much less than the assumed values.

Especially in summer, when the population increases and the highest temperatures occur, this reserve, which is approximately one third of the whole design capacity, can be used to handle the higher loads.

The plant in the first design capacity consists mainly of intake pumps, a trash screen, a sand tank, biological sewage treatment facilities with phosphorus precipitation, settling tank, backflow pumps, and a sludge storage tank. The sludge treatment portion has already been designed for the largest design capacity of the plant and the additional sludge from the decentralized compact plants. It only stores the fully stabilized sludge. The plant can be made even more flexible by giving it the capability of accepting sludge from additional sewage storage tanks of households which are not yet connected to the sewage system. This facility only consists of an additional spiral trash screen to remove solid materials and an additional storage tank to store the remaining liquid wastes. This sewage water is dosed to the sewage plant overnight, when the sewage loads are usually very low.

This specially designed receiving unit for faecal sludge increases the plant capacity by approximately 50% of its original size or in this case to 15,000 population equivalent according to the German guidelines. Together with the mentioned reserve of one third of the design capacity, the plant can easily serve for 18,500 population equivalents in summer.

The next design capacity can basically handle the waste water of approximately 30,000 population equivalents. Due to the modules and simplicity of the enlargement, the second design capacity can be achieved at half of the costs of the basic design.

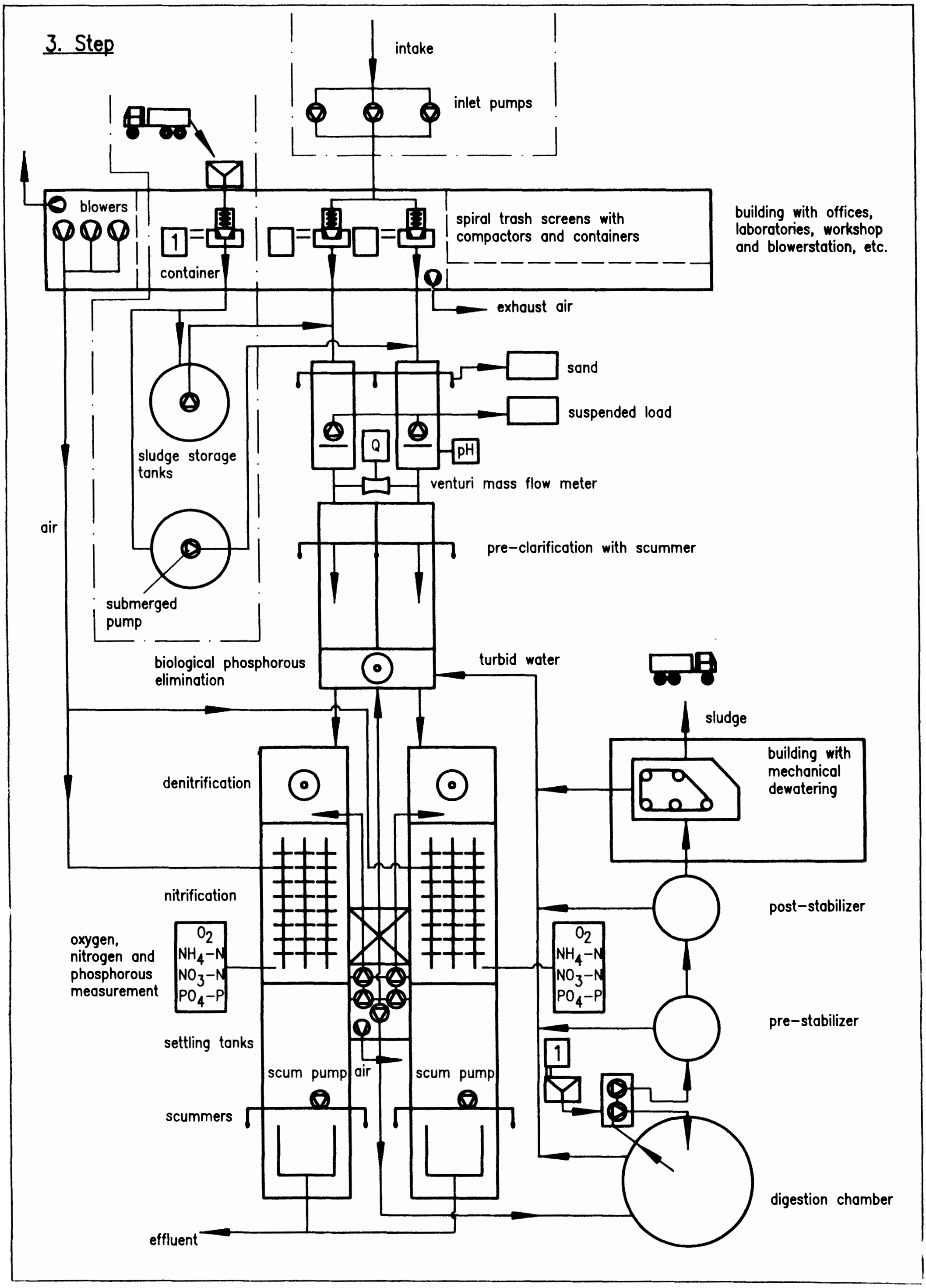

Figure 3. Final design capacity.

A second trash screen and sand trap are included as well as a second line for the biological sewage water treatment. Since the plant already has the possibility of a simultaneous nitrification and denitrification in the first design capacity, one can now use preliminary denitrification. This is obtained by dividing the biological tanks into two parts: one for the denitrification and a second one for the nitrification. The sludge treatment tank is built up to a complete digester chamber for the now partly stabilized sludge and completed by a pre- and post-stabilization tank. To the receiving unit for faecal sludge a second storage tank is added to expand the design capacity of the plant to 40,000 population equivalents. Together with the reserve in summer that leads to a peak capacity of 50,000 population equivalents.

In the final step, pre-clarification, including biological phosphorus elimination, will be added to the existing plant. The basic capacity will be enlarged then to nearly 45,000 population equivalents. The costs will be similar to the second design capacity. Fig. 3 shows the final design capacity, including pre-clarification and biological phosphorus elimination as well as a mechanical sludge dewatering unit to complete the sludge treatment. If one now adds the kept reserve of approximately one third of the design capacity the plant can handle load peaks up to 65,000 population equivalents plus the 10,000 population equivalents due to the two receiving units for the faecal sludge of surrounding communities not connected to the sewage works. That makes maximum capacity of approximately 72,500 population equivalents for the final design capacity.

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