10.1.5 Limitations and constraints

The selected solution in a specific design case depends on legal requirements, but also on other considerations such as the possible reuse of the effluent, the available area for construction, available funds (also taking into account the cost of the sewer system), the environmental and economical impact of the treatment plant and the availability of skilled employees.

Together with the legal requirements, the possible reuse of the effluent can determine the effluent standards. If for example the effluent is to be used for irrigation, it is advantageous to leave the nutrients in the effluent and thus to reduce the utilisation of chemical fertilisers.

On the other hand, if the effluent is discharged to surface waters then nutrient removal may be of critical importance. In developing countries many people still do not have access to a public drinking water network. Therefore it should be taken into account that surface waters might be used for human consumption, in which case the hygienic quality of the water is very important. It might be necessary to remove pathogens and include post-treatment steps such as disinfection (chorine, ozone, UV), filtration or biological units such as stabilisation ponds and helophyte filters.

Limited availability of funding can also influence the design. If the available resources are insufficient to comply with the legal requirements, it may be necessary to construct an imperfect system from a legal perspective, but within the financial possibilities and thus avoiding the possibility that nothing is done at all.

In this chapter it will be demonstrated that pre-treatment of sewage with a UASB reactor will considerably lower the total investment cost of an activated sludge system (although only at sufficiently high ambient temperature). Thus, if financial resources are limited, construction should start with a UASB reactor removing most of the organic material in the influent, leaving for a later date the post treatment in an activated sludge system. Even in the event that at a later stage the anaerobic pre-treatment step is deleted (for example to allow biological removal of nutrients), the UASB unit can still be useful as a sludge digester.

It is important to realise that the construction costs of a sewer system are often much larger than that of the actual waste water treatment plant. Therefore in many cases it is possible to reduce investment costs significantly when several smaller decentralised treatment plants are built in a city instead of a single central treatment plant. The installation of high cost large diameter sewage pipes and pumping stations can be avoided.

To illustrate this point, in the Netherlands a large waste water treatment plant (1.3 million people equivalents) has been constructed near the city of The Hague, replacing several smaller treatment plants. While the total investment is approximately 400 M€, the pressure lines and pumping stations directing the raw sewage to the waste water treatment plant and discharging the treated effluent to sea amount to more than 50% of the costs. This does not even include the costs of the sewer collection system in the city itself, as this is already in place. However, the cost of purchasing building area inside the city limits is very high and locating decentralised waste water treatment plants in several parts of the city would probably not be easy.

On the other hand it may be advantageous to centralise certain operations (for example sludge treatment). In this case all local waste water treatment plants may pump or transport their excess sludge to a central sludge treatment unit. An interesting concept, applied by SANEPAR in the Brazilian state of Paraná, is to treat the waste water locally by UASB reactors and to leave the post treatment (which will be centralised) for a later stage.

Frequently in developing countries it is decided to implement only secondary treatment, as tertiary treatment is considered to be an expensive sophistication only applicable for regions with ample resources. In this book this point of view is disputed for the following reasons: (1) the cost difference between a system for secondary treatment and a system designed for nutrient removal is not very large, (2) secondary treatment may lead to many operational problems in regions with a hot climate, and (3) the nutrient removal system will have a superior effluent quality. For these reasons in general the construction of a tertiary treatment system for nitrogen removal is justified.

Another misconception is that the activated sludge system is too complex to be operated in developing countries. Although the presence of qualified operators and maintenance technicians is required, the degree of technical difficulty of an activated sludge system is in fact not very high. In a country like Brazil with a large industrial base there are literally thousands of factories that are much more complex. The frequent failures of activated sludge systems are not because of their technical complexity, but due to other factors such as inadequate design and lack of priority given to treatment systems by water and waste water companies, resulting in inadequate operation and maintenance.

However, at present there are many large waste water treatment systems in Brazil with good and stable performance: examples are the carrousels in Belém and Curitiba (SANEPAR) and the large secondary waste water treatment plant of CETREL at the petrochemical complex of Camaçari in Bahia. These systems have been in operation for more than three decades and have demonstrated excellent operational stability and a high quality effluent.