Preface

Water supply systems are crucial in supporting industrial oil, gas, and other chemical processing systems. Reliability of supply and cost of water to such industries is important for both the sustainable management of such industries and for the provision of a supply market. This book, therefore, overviews and introduces the technical matters related to the process design and selection of water supply systems used in such industries. In doing so, it provides an introduction to the field of industrial processing water supply management, and a frame for further engagement in the detailed literature of this field.

Both process design and process selection of the many water supply systems used in oil, gas, and chemical processing industries are crucial for the maintenance of existing facilities and the design of next-generation processing industries. Simply put, oil, gas, and most chemical processing plants cannot function without water-based utility systems. Although the importance of these systems is not usually contested, expansion or upgrade expenditures of these operations are often avoided, because no direct payback can be assigned to any utility capital expenditures.

The cost of supplying water for steam, cooling, and processing varies greatly, depending on the water source. Water typically comes from sources such as on-site groundwater wells, surface water, or off-site providers. These supplies often have flow limit restrictions, and the purchasing water can be expensive. There may also be additional regulations enforced when demand exceeds permitted limits. Moreover, the cost for raw water treatment (chemical additives, softeners, and flocculants), sludge disposal, pumping, and other processing, rises with increased water demand.

Water use at a plant can increase for many reasons; hence plant expansions and unit conversions can impact utility systems by boosting flows and contaminant loading. In addition, new and modified units may contribute to increased storm water runoff, and more stringent quality specifications may also increase water demand from increased washing/treatment steps.

The aim of this book is to provide an overview of the main technical points related to the process design and selection of water supply systems used in the oil, gas, and chemical processing industries. This overview is framed around four systems that, together, provide an integrated industrial water management system.

- Water treatment system
- Raw water and plant water system
- Water pollution
- Fire water distribution and storage facilities

There is a direct relationship between water demand and flows to water treatment. Consequently, many water treatment and wastewater units are designed for peak flows only experienced during storm conditions. Treatment costs during these peak flow conditions can climb exponentially from increased pumping, aeration demands, sludge management, and solids disposal requirements. Most importantly, additional water use reduces treatment capacity during peak flows often resulting in the need for additional storage capacity to dampen these peaks.

The field of process water design is broad, and contains a wide range of subjects, each of paramount importance including raw water treatment and recovery systems. The treatment of both water and wastewater involves a sequence of treatment steps. All water and wastewater treatment processes involve the separation of solids from water in at least some part of the operation and removal of biochemical oxygen demand (BOD) to some extent. The end of pipe treatment sequence can be divided into the following elements: primary or pretreatment; intermediate treatment; secondary treatment; and tertiary treatment plus ancillary, sludge dewatering, and disposal operations.

Optimizing the performance of individual unit operations, such as gravity separator, dissolved air flotation, biological treatment, etc., can best be achieved if:

- the properties of influent streams are considered;
- the chemical principles that are used in solids pretreatment are understood;
- the variety of chemicals available for solids treatment is recognized;
- the properties of effluent water are established based on the local environmental regulations and final disposal; and
- the protocols for quantifying results are identified.

Effluent wastewaters are a combination of the liquid and water-carried wastes from buildings, industrial plants, plus groundwater, surface water, or storm water. Wastewater may be grouped into the following classes [5–8]:

Class 1 Effluents that are non-toxic, and not directly polluting but liable to disturb the physical nature of the receiving water, may be improved by physical means.

Class 2 Effluents that are non-toxic, but polluting because they have an organic content with high oxygen demand, may be treated for removal of objectionable characteristics by biological methods.

Class 3 Effluents that contain toxic materials, and therefore are polluting, may be treated by chemical methods.

Class 4 Effluents that are polluting because of organic content with high oxygen demand and, in addition are toxic, may require a combination of chemical, physical, and biological processes.

The final release of effluents and surface water drainage to the broader environment is subject to the approval of environmental scientists and experts, a factor that must be borne in mind in the early stages of design. In general, the aim of any drainage/effluent disposal system should be to segregate uncontaminated water from contaminated water or effluents and to segregate different types of effluents in order to reduce the size, complexity, and costs of any treatment units which may be required for handling the contaminated water and effluents before they are discharged from oil, gas, and chemical processing plants.

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