Chapter 1

Introduction

For conveying fluid, it is difficult to imagine a chemical process plant without piping. A pipe network of fluid supply can be one of the most important part of total investment for a chemical plant. Coker(1991) stated that the initial investment of piping in the chemical process industries had been shown to cost around 20-40% of the total plant investment. Energy usage and continued maintenance often add to the cost. Sound sizing practices can therefore have a substantial impact on overall plant economics. It is a responsibility of designer to optimize pressure drop in piping and equipment to assess the most economic condition.

For decades, chemical engineers have used various rules of thumb for selecting the size of pipe in continuous process plants. Often these methods result in sizes that are not the correct selection for the operating conditions. This causes the plant to be less efficient to operate or more costly to erect. According to emphasis on conservation of power and material resources, a rational method for proper pipe size selection that results in the least annual cost with highest performance is essential. An optimum piping design came to play in a major role during World War II.

At that time, newer processes were introduced into the petrochemical industry that included parameters and operating conditions of a wholly different character from common experiences in earlier years, so that the designers were practically unobtainable. To handle these challenges, an approach of optimum pipe design was created (Note, 1978).

When a fluid is being set into motion by a pump, the whole idea is to balance fixed cost of construction with pumping cost to provide a size that results in the lowest annual charge for the pipe system. Under the same flowrate, the fixed cost of pipe increases directly with increasing diameter, whereas the pumping costs decrease with increasing diameter (Figure 1.1). The value of this optimum economic pipe diameter is found at the point at which the sum of pumping and fixed charge gives a minimum (Peter and Timmerhaus, 1968; Nolte, 1978; Coulson and Richardson, 1983).

To obtain solution of this optimal piping design problem, various researchers have proposed the use of *mathematical programming* techniques. They formulate the design problem as *mathematical models*. Since the solution often obtains a stage to select a candidate data of commercial available pipe sizes, data management is necessary. The data can be managed manually when the number of data is small. However, it becomes difficult tasks in practice because many projects usually contain the large amount of data. Not only taking a long time to manage data but it is also sensitive to have an error. The *database management system* (DBMS) technology seems to be the most suitable approach.

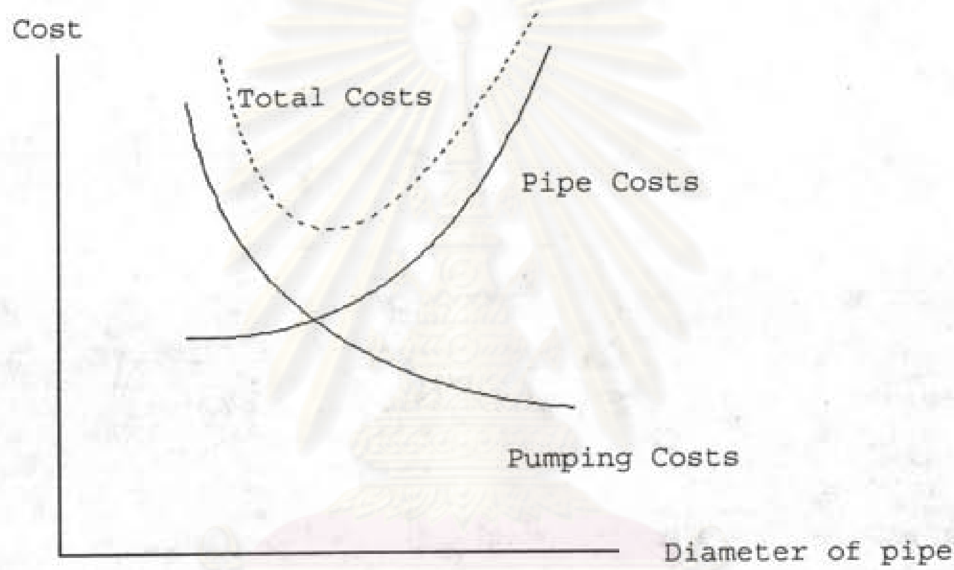

Figure 1.1: Pipe, pumping and total costs for pipeline example.

In the past, three commercially popular database models have been widely used: hierarchical, network, and relational. Generally, the relational database (RDB) model seems to be useful for engineering applications. The model represents data relations in the form of flat tables. Earlier, the first chemical process engineering database design project was based on this model. However, the design of relational database has largely been determined in response to the needs of typical business applications. Engineering design applications are often too complex data to be modelled by the relational model (Ahmed, 1992). Therefore, it is ineffective for designing an engineering database. Most successful chemical engineering database systems were not based on the relational model but relied on *ad hoc* approach (Huang and Fan, 1988). Recently, *object-oriented database* (*OODB*) model has been presented. This technique encourages the kind of evolutionary development that often occurs with complex engineering problem. It seems to be the most suitable for engineering work.