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KLM Technology Group #03-12 Block Aronia, Jalan Sri Perkasa 2 Taman Tampoi Utama 81200 Johor Bahru	STORAGE TANK SELECTION AND SIZING (ENGINEERING DESIGN GUIDELINE)	Author: Rev 1 Karl Kolmetz Rev 2 Aprilia Jaya Checked by: Karl Kolmetz

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INTRODUCTION

Scope

This design guideline covers the sizing and selection methods of a storage tank system used in the typical process industries. It helps engineers understand the basic design of different types of storage tank systems and increases their knowledge in selection and sizing.

The selection section contains the explanation for the suitability of types of tank system used in processing industries, which are based on the environmental regulations, location, and process materials involved.

All the important parameters used in this guideline are well explained in the definition section which helps the reader understand the meaning of the parameters and the terms used.

The theory section includes sizing theory and formulations for the tanking systems design.

In the application section, three cases examples are included by guiding the reader step by step to do tank sizing.

In the end of this guideline, example specification data sheets for the tank system are included which is created based on an industrial example. Calculation spreadsheet is included as well and to aid user more understand and to apply the theory for calculations.

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General Design Considerations

Storage vessels containing organic and non organic liquids and vapors can be found in many industries, including;

- (1) petroleum producing and refining,
- (2) petrochemical and chemical manufacturing,
- (3) bulk storage and transfer operations, and
- (4) other industries consuming or producing liquids and vapors.

Liquids and vapors in the petroleum industry, usually called petroleum liquids or vapors, generally are mixtures of hydrocarbons having dissimilar true vapor pressures. Examples would include jet fuel, diesel, gasoline and crude oil.

Liquids and vapors in the chemical industry, usually called volatile organic liquids and vapor, are composed of pure chemicals or mixtures of chemicals with similar true vapor pressures. Examples would include benzene, styrene, and alcohols).

Liquids and vapors in the bulk storage and transfer operations can be organic or hydrocarbon in nature. Example would include all of the above including acids and bases.

All those chemical should keep in the right storage tank. Design and safety concern has come to a great concern as reported case of fires and explosion for the storage tank has been increasing over the years and these accident cause injuries and fatalities. Spills and tank fires not only causing environment pollution, there would also be severe financial consequences and significant impact on the future business due to the industry reputation.

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TYPES OF STORAGE TANKS

Seven types of vessels are used to store volatile organic liquids:

1. Fixed-roof tanks;
2. External floating roof tanks;
3. Internal floating roof tanks;
4. Domed external floating roof tanks;
5. Horizontal tanks;
6. Pressure tanks; and
7. Variable vapor space tanks.

The first four tank types are cylindrical in shape with the axis oriented perpendicular to the foundation. These tanks are almost exclusively above ground. Horizontal tanks (i.e., with the axis parallel to the foundation) can be used above ground and below ground.

Pressure tanks often are horizontally oriented and "bullet" or spherically shaped to maintain structural integrity at high pressures. They are located above ground.

Variable vapor space tanks can be cylindrical or spherical in shape.

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1. Fixed-Roof Tanks

Of currently used tank designs, the fixed-roof tank is the least expensive to construct and is generally considered the minimum acceptable equipment for storing VOL's (volatile organic liquids). A typical fixed-roof tank, which is shown in Figure 1 below, consists of a cylindrical steel shell with a cone- or dome-shaped roof that is permanently affixed to the tank shell. Most recently built tanks are of all-welded construction and are designed to be both liquid- and vapor-tight. However, older tanks may be of riveted or bolted construction and may not be vapor-tight.

A breather valve (pressure-vacuum valve), which is commonly installed on many fixed-roof tanks, allows the tank to operate at a slight internal pressure or vacuum. Breather vents are typically set at 0.19 kPa (0.75 in. w.c.) on atmospheric pressure fixed-roof tanks. Because this valve prevents the release of vapors during only very small changes in temperature, barometric pressure, or liquid level, the emissions from a fixed-roof tank can be appreciable.

For fixed-roof tanks, the nominal capacity is the geometric volume from the bottom of the tank up to the curb angle, which is a metallic angle that is welded along the periphery at the top of the cylindrical portion of the tank.

Additionally, gauge hatches/sample wells, float gauges, and roof manholes provide accessibility to these tanks and also serve as potential sources of volatile emissions. Breather vents may be called conservation vents, although hardly any conservation of vapors occurs at such low pressure settings. Generally, the term conservation vent is used to describe a pressure setting of 17 kPa (67 in. w.c.) or less. Vents with settings greater than 17 kPa (67 in. w.c.) are commonly called 'pressure' vents.

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