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<tr><td>KLM Technology Group
#03-12 Block Aronia,
Jalan Sri Perkasa 2
Taman Tampoi Utama
81200 Johor Bahru
Malaysia</td><td colspan="2">PROCESS REQUIREMENTS OF CAUSTIC AND CHEMICAL INJECTION SYSTEMS

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SCOPE

Wherever explosion or fire hazard exist, proper plant layout and adequate spacing between hazards are essential to loss prevention and control. Layout relates to the relative position of equipment or units within a given site. Spacing pertains to minimum distances between unit or equipment.

This Project Engineering Standard covers the basic requirements of the plant layout and spacing of oil & gas refineries, petrochemical and similar chemical plants to ensure safety and fire prevention together with ease of operation and maintenance.

DEFINITIONS AND TERMINOLOGY

Back Pressure – (a) The pressure on the outlet or downstream side of a flowing system. (b) In an engine, the pressure which acts adversely against the piston, causing loss of power.

Controlled-Volume Pump - A controlled-volume pump is a reciprocating pump in which precise volume control is provided by varying effective stroke length. Such pumps also are known as proportioning, chemical injection, or metering pumps. (1) In a packed-plunger pump, the process fluid is in direct contact with the plunger. (2) In a diaphragm pump, the process fluid is isolated from the plunger by means of a hydraulically actuated flat or shaped diaphragm.

Inhibitor - A substance, the presence of which in small amounts, in a petroleum product prevents or retards undesirable chemical changes from taking place in the product, or in the condition of the equipment in which the product is used. In general, the essential function of inhibitors is to prevent or retard oxidation or corrosion.

Multiple Feed - Multiple feed is the combination of two or more pumping elements with a common driver.

Slurry - A free-flowing mixture of solids and liquid.

SYMBOLS AND ABBREVIATIONS

DN : Diameter Nominal, in (mm).

DP : Differential Pressure.

F : Flow.

ID : Inside Diameter, in (mm).

KO : Knock-Out.

LP : Low Pressure.

LPG : Liquefied Petroleum Gas.

max. : Maximum.

min. : Minimum.

No. : Number.

NPSH : Net Positive Suction Head, in (m).

ppm : Parts per million.

PC : Pressure Controller.

PIC : Pressure Indicator Controller.

TC : Temperature Controller.

TI : Temperature Indicator.

TIC : Temperature Indicator Controller.

TPC : Technical Practices Committee.

vol. : Volume.

UNITS

This Standard is based on International System of Units (SI), except where otherwise specified.

PROCESS REQUIREMENTS OF FRESH & SPENT CAUSTIC UNITS

1. Fresh Caustic Unit

General

Fresh caustic Unit shall involve but not limited to the following:

a. Preparation and storage of strong and dilute caustic solution, including storage facilities for the regenerated caustic from LPG Caustic Treating Section.

b. Transferring the proper caustic solution strength to the plants or process Units where required with available pumps.

c. Supplying strong caustic solution (typically 50% by mass) for the Unit by means of solid caustic or available strong caustic solution from existing petrochemical plants.

Design requirements

a. The temperature of the solution to the suction of caustic transferring pump during transferring from caustic dissolving tank shall not exceed 98°C.

b. Connections of cold condensate or demineralized water addition shall be considered for diluting the contents of caustic dissolving tank and each of the dilute caustic tanks, to prepare desired concentration.

c. The capacity of dilute caustic tanks shall be enough to provide continuous make-up caustic, during catalyst regeneration of Catalytic Unit.

d. Provision of the tank heaters (typically by use of LP steam) shall be considered for caustic tanks to maintain the solutions above their freezing points.

e. Caustic tanks shall be provided with temperature and level indicators as well as air spargers for homogenizing the solutions and/or to maintain constant bulk temperature

f. The regenerated caustic that is purged continuously from the regenerative caustic treating section in the LPG Unit should be stored in regenerative caustic tank in fresh caustic Unit area.

g. Pump(s) shall be provided to pump constantly fresh caustic from dilute caustic tanks, to regenerative caustic treating section to maintain the content of Na_2S and other impurities less than specified value (typically 2% by mass).

h. Regenerative caustic solution shall be used in non-regenerative batch caustic wash treating for H_2S removal throughout the refinery/plant.

i. Dilute caustic pumps shall be provided to pump the regenerative caustic where required. In addition these pumps shall be used to transfer fresh dilute caustic from appropriate tanks under the following circumstances:

   1. To supply fresh caustic to the Catalytic Unit.

   2. To supply fresh caustic in absence of regenerated caustic

j. Pump(s) shall be provided to pump constantly fresh caustic from dilute caustic tanks into the line carrying sour water produced in regenerative caustic treating section, to the sour water plant.

k. The overflows and drains of all caustic tanks in fresh caustic Unit area and drains of non-regenerative caustic wash treaters shall be drained in a closed loop drainage system which is led to caustic sump pit in Spent Caustic Treating Unit.

2. Spent Caustic Treating Unit

General

a. The purpose of Spent Caustic Treating Unit shall be to improve the quality of spent caustic up to the point, that it is not harmful to the environment, before sending it to the water sewer.

b. The Spent Caustic Unit as a typical may involve but not limited to the following equipment::

   1. Spent caustic drains sump.

   2. Spent caustic drains pump.

   3. Spent caustic surge tank.

   4. Spent caustic feed pump(s).

   5. Spent caustic oxidizer(s).

   6. Hydrochloric acid tank.

   7. Caustic oxidizer effluent separator.

8. Spent caustic filter (s).
9. Spent caustic cooler.
10. Static HCl acid mixer.
11. Spent caustic degassing vessel.

Design requirements

a. In case of existence of oil in spent caustic drains sump, an oil separator with internal baffle shall be installed to remove the oil from spent caustic before transferring to spent caustic surge tank.

b. Automatic level control system shall be provided to transfer the entrained oil to API separator.

c. Provision of cold condensate addition shall be made to dilute the spent caustic feed line to desired concentration of contaminants, before entering the spent caustic surge tank.

d. Provision of tank heater (typically by use of LP steam) shall be considered for spent caustic surge tank to maintain the contents of tank above its freezing point.

e. A series of stirred reactors shall be provided to convert the sulphide contained to thiosulphate/sulphate with atmospheric oxygen at proper temperature and pressure.

f. The utility air injection shall be flow controlled to the bottom of each reactor, through convenient distributor.

g. The temperature of the reactors could be logged and controlled (TIC) by the injection of live steam to the reactor through air distributor line to supplement the heat of reaction.

h. Vent gases and effluents from the reactors shall be discharged to effluent separator, from where, the gas (essentially air) should be sent to atmosphere at safe location.

i. The pressure in the reactors and effluent separator should be monitored and maintained by pressure indicator controller (PIC) for controlling the gas discharge to atmosphere.

j. Dual filters and cooler shall be provided to filter and cool (typically up to 35°C) the treated liquid effluent from effluent separator.

k. A mixer shall be provided for mixing the hydrochloric acid solution (typically 30% by mass) with effluent liquid from cooler.

l. A storage tank for hydrochloric acid with appropriate transferring pumps shall be provided for neutralization system mentioned above.

m. A degassing vessel shall be provided to enter the neutralized solution.

n. Level indicator controller shall be provided to discharge the neutralized solution (treated spent caustic) to the water sewer.

o. The size and numbers of series reactors shall be chosen to reduce the sulphide content of liquid effluent from the last reactor to acceptable standard figure.

CHEMICAL INJECTION SYSTEMS

Chemical Feed Systems-General

Chemical feed systems shall be designed to ensure high reliability and have flexibility enough to cover contingencies that might arise. The required volume of chemical as well as its physical and characteristics should also be considered in the feed system design.

Feed concepts. The method by which a chemical is added shall be suited to both its intended use and the system into which the product is being added. Feeding mechanisms should be categorized to: intermittent feed, slug feed, continuous feed, and shock feed:

a. Intermittent feed

Intermittent feed is on/off feed, over an extended time span, with chemicals added at fixed intervals to a threshold level of treatment.

b. Slug feed

Slug feed involves the addition of chemical in excess of the amount required to produce a desired concentration after a specific time interval. As make-up is added to compensate for system losses over a period of time, the residual is gradually lowered to an unacceptable level, therefore requiring another slug.

c. Continuous feed

Continuous feed is the method most commonly encountered. It may be manual, providing a constant rate of chemical addition, or it might be automatic, the feed rate being automatically adjusted in response to some measured variable such a pH or flow rate. Feeders which cycle on and off over short time spans shall also be considered continuous.

d. Shock or shot feed

Shock feed is a specialized form of slug feed as applied to the introduction of micro-biocides to recirculating cooling system. Shock feed is utilized to provide maximum benefit from the "kill" effect on microbiological growths afforded by a high level of treatment.

Chemical feeders

Chemicals used in chemical injection system are added by means of devices called chemical feeders. These feeders are classified as, wet feeders, dry feeders, and gas feeders:

a. Wet feeders are designed to feed solutions only, or solutions and suspensions.

b. Chemicals in solid form are fed with dry feeders and gases with gas feeders.

Important design notes on some of chemical feeders are as bellow

a. Water-jet eductor

   Application of water jet eductors is limited by the amount of lift or suction necessary, by available motive pressure and by discharge pressure. Generally, a ratio of at least 3.5 : 1 for motive and discharge pressure is necessary.

b. Positive displacement pump