At the Sulphur 2012 Conference in Berlin, Enersul ran a workshop on how to design a sulphur handling facility. Approximately 40 delegates took part in the workshop which was presented by Nick Rasberry, Technical Sales Manager of Enersul LP, Canada and Eric Harbaugh, Director of Enersul LP, USA.

After an introduction to sulphur forming and handling, the workshop concentrated on the many design considerations that need to be taken into account when designing a sulphur handling facility, before giving the participants a chance to try their hand at working in small groups to design their own facilities based on some actual case studies.

It soon became apparent that when designing a sulphur handling facility many factors need to be taken into consideration and the quality of the information provided from the outset is very important.

When designing a sulphur handling facility, the basic engineering design data (BEDD) covers location, site and plant data. The liquid sulphur feedstock is very important when designing a facility, before giving the participants a chance to try their hand at working in small groups to design their own facilities based on some actual case studies.

Typical liquid sulphur feedstock conditions (IPSA – Vancouver) are:

- Temperature: 122 to 145°C
- Sulphur purity: 99.9%
- Colour: bright yellow (solid)
- Carbon: max. 250 ppm by wt
- Ash: max. 500 ppm by wt
- Arsenic: max. 0.25 ppm by wt
- Selenium: max. 1.0 ppm by wt
- Tellurium: max. 1.0 ppm by wt
- H2S: max. 10 ppm by wt
- Moisture: max. 1 wt-%

SUDIC specifications (1978) for formed sulphur quality are listed below:

- Shape: generally spherical (2-6 mm)
- Friability: ≤ 1% SLI, ≤ 2% SLII
- Moisture: ≤ 0.5%
- Bulk density: 1,040 kg/m³ (loose), 1,200 kg/m³ (packed)
- Angle of repose: >25°
- Particle size distribution (PSD):
  - Screen size (mm): % Retained
    - 6.30: <5
    - 5.60: <25
    - 2.80: >75
    - 1.18: >98
    - 0.3: >99.5

The plot plan for a sulphur handling facility is an architectural, engineering and/or landscape drawing or diagram which shows the buildings, utility runs and equipment layout, the position of roads and other constructions at a proposed project site at a defined scale. It is important to determine: whether the plot plan has been defined, the available area, whether the plant is on a greenfield site or a brownfield site and the plant type e.g. gas plant, refinery or other.

The ambient conditions, i.e. the common prevailing and uncontrolled atmospheric and weather conditions for a place need to be taken into account. It includes but is not limited to: temperature (high, low and design); barometric pressure; wind load, speed and predominant direction; relative humidity (high, low and design); seismic design data; snow load and noise level.

A hazardous location is defined as a place where concentrations of flammable gases, vapours or dust occur. Electrical equipment that must be stored in such locations is specially designed and tested to ensure it does not initiate an explosion, due to arcing contacts or high surface temperature of equipment.

Environmental regulations vary in different parts of the world. They are an amalgam of state and federal statutes, regulations
and common-law principles covering air pollution, water pollution and hazardous waste. For example, discharge limits apply to H₂S, SO₂, particulates, water (pH and contaminants) etc. and may require the installation of a scrubber, water retention and/or treatment and dust suppression.

Available utilities need to be assessed. These include, but are not limited to;
- steam, thermal oil or equivalent;
- process water;
- instrument air;
- utility air;
- plant water (wash down);
- fire water;
- electrical power (motors, lighting, heating etc.).

The design parameters include requirements set out by the owners, front end engineering design (FEED) contractors and operators for the proper operation of the plant. These include but are not limited to: capacity, availability, flexibility and redundancy.

The availability is the ratio of the total time a functional unit is capable of being used during a given interval to the length of the interval and normally refers to the availability of the individual equipment as well as the availability of the entire facility. When designing the availability, the following factors need to be considered:
- capacity (excess);
- number of process streams;
- load-out capacity;
- solid sulphur storage;
- emergency storage.

Flexibility refers to the ability of designs to adapt when external changes occur and is normally expressed as a percentage for capacity or a turndown ratio. For example, a system that has a maximum capacity of 1,000 t/d and a flexibility of 25% to 110% would have a design capacity of 250 to 1,100 t/d.

Redundancy is the duplication of critical components or functions of a system with the intention of increasing the reliability of the system. It can be built-in or alternatively multiple process streams can be used. The more critical the process is, the greater the sparing capacity. Other factors to consider include: site location, maintenance procedures and spare parts inventory. Figure 1 shows three options for a 2,000 t/d forming facility with different redundancy.

In order to provide FEED specifications many questions need to be answered:
- **Liquid sulphur** – Is it required? Will it be carried out by the vendor or others? Is contaminant removal required? Is redundancy required?
- **Sulphur block pouring** – What are the requirements for capacity, total storage capacity, block dimensions, flexibility, availability, redundancy and operating schedule?
- **Sulphur remelter** – Is the feed material block sulphur, crushed bulk or formed? What are the requirements for melting capacity, flexibility, availability, redundancy? Preferred type e.g. in-situ, HEM, tank or pit?
- **Sulphur forming** – What are the requirements for capacity, flexibility, availability, redundancy and distance? What type(s) e.g. troughing conveyor, tipper conveyor, stacker, high angle conveyor, cambelt, pipe conveyor, slewing stacking conveyor, bucket elevator, Z-type conveyor, other?
- **Sulphur storage and reclaiming** – What are the requirements for capacity, flexibility, redundancy and distance? What type of storage, e.g. bin, silo, stockpile, warehouse, other? What are the requirements for capacity and redundancy? What method will be used for reclaiming sulphur from storage, e.g. gravity, frontend loader, conveyor, reclaim, other? What are the capacity and redundancy requirements?
- **Sulphur bagging** – What are the requirements for capacity, bag size, frequency, flexibility, availability and redundancy?
- **Truck load-out** – Is it solid or liquid sulphur? What are the requirements for capacity, rail car size, train size, frequency, flexibility, availability and redundancy?
- **Rail load-out** – Is it solid or liquid sulphur? What are the requirements for capacity, rail car size, train size, frequency, flexibility, availability and redundancy?
- **Shiploader** – Is it solid or liquid sulphur? What are the requirements for capacity, vessel size, frequency, flexibility, availability and redundancy?

The workshop provided a valuable insight into the many options that are available when designing a sulphur handling facilities and the importance of detailed knowledge and experience to achieve the optimum solution.