Case Study #3: Conversion & upgrade of an existing slurry system. The development of the present ‘Closed Coke Slurry System’

History:
A 2-drum Coker operator in Europe used a closed Slurry system for his coke since start up of the Coker unit in 1984. From the early planning stages for the project, the local authorities for environmental reasons stipulated reliable means to suppress steam plume, dust entrainment and release of hydrocarbons (HC) & volatile organic components (VOC) into the atmosphere and residential areas nearby for the entire chain of production and storage & loading.

As at that time no package unit for such service was available, the engineering contractor in conjunction with the client, created a conceptual solution, specified, and purchased commercially available components, e.g. Crusher, Slurry pumps and Screens for the dewatering bins. The contractor designed all other components, e.g. Sluiceway, Coke pit, bins and water tanks and remaining appurtenances for a closed system. An enclosed conveyor system transports the coke to the remote silo storage area with dust free loading to either railcars or trucks.

For quality reasons and as the operator planned to produce three coke grades (sponge, calcinate and needle coke), the cutted and crushed coke batch was splitted via a vibrating sieve. Coarse material was directed to a bucket conveyer, while the smaller coke lumps were pumped. The dewatering bin received both streams.

Early conducted tests and samplings demonstrated that the slurry pump did not increase the fines percentage at all as assumed earlier, leading to abandon the spitted transport concept with the crucial and unreliable sieve. All produced coke is since then pumped.

Soon after start up and in the following years of operation, it became obvious that the coke slurry area constitutes a bottleneck for an uninterrupted, continued operation. Earlier as expected failure of the mechanical equipment, erosion and corrosion effects or component replacement due to premature wear and tear caused unplanned shut downs for repair.

Coker reliability fell down to as low as 75% in lieu with increasing maintenance cost and production losses.
It became clear that repair alone or replacement in kind would not yield improve the reliability and cost situation.
Over time, TRIPLAN as local engineering contractor familiar with the Coker material handling process and the mechanical requirements was involved with key personnel to support the owner operator with the objective to improve the initial system concept for reliability and integrity of the equipment. In the course of this task, TRIPLAN continuously developed innovative methods in coke dewatering, fines handling, and sludge management over a span of more than 25 years.

Development and achievement highlights:

- **Crusher**

  **Initial status:**
  Crusher supplied as commercially available industrial equipment, grinding of dry ore or coal with uniform loads.

  **Interim steps & achievements:**
  - replaced electrical multi-V-belt drive to direct hydraulic drive after extensive studies of coke cutting methodology, coke impact loads and resulting grinding forces
  - New Roll geometry, teeth shape and pattern with academic support from Freiberg University of Mining to cope with high impact cutting loads/avalanche effect
  - Bearings and mechanical seals replacement to guard from water ingress
  - Developed complete new crusher casing with unique triple material combination with extreme high erosion and corrosion resistance

  **Present Status:**
  New developed tailor made crusher with unique superior mechanical and metallurgical features.
  The Crusher is now in uninterrupted service for 8 years or more then 4.000 cycles. Last inspection (2012) shows no sign of erosion/corrosion.

- **Sluice way**

  Increased Slope, previously constructed with non-optimum angle causing often clogging if cutting rates were too erratic.
  Replaced sacrificial material (e.g. ceramic tiles, basalt lining) with erosion and corrosion resistant solid material.
  Present run length and condition corresponds with crusher.

- **Sludge management**
TRIPLAN initiated various improvements to optimize quench water routing in
the system. TRIPLAN suggested adding a second water pit/aboveground basin to handle run
down water from the dewatering pit separately. Developed Operating steps to maintain coke fines/sludge within coke batch.

- Dewatering bin
  Intensive tests and studies of the behavior of dewatering a coke/water system
  and applying the relevant physical laws led to modifications in the screen
  arrangement with now optimum slot pattern.
  Invented utilization of Coke bed for filtering fines
  With the utilization of the cone-section to dewater the lower coke batch, the
  bin became a high performance-dewatering device.

- Slurry pump
  **Initial status**
  Commercial supplied equipment used for pulp/ore, which was susceptible for
clogging, corrosion and cavitation and generally not at par with the
performance expectations.

**Present status:**
Tailor-made designed and constructed pump and impeller with appropriate
material selection to resist cavitation, erosion and corrosion with special
casting material for long life.

Take away:
It was a long way from the early planning, design and engineering phase to
transform the requirements for an Emission-free Coker from the local
authorities and additional owner operational requests from a concept with no
precedence into a success story.
Commercially available components, mainly from the coal and ore supplier
market, were not at par – and still are not - to satisfy the harsh and wet
conditions at elevated temperatures with non-uniform loads that prevail in a
Delayed Coker.
Except for the principal concept – leave the first omission, the split-transport of
coke to the dewatering bins alone - together with the still unchanged size of
tanks and bins, all other components have been undergone major
modifications or total replacement with the aim to make the system fit for
purpose.
From start up to the last ultimate modifications 8 years ago, TRIPLAN was instrumental in the improvement of the Closed Coke Slurry System. The step where the formed coke leaves the chemical process part of the unit and enters the area of solids handling via cut out, creating an array of mechanical and metallurgical problems is truly unique in the Hydrocarbon Industry. TRIPLAN has accumulated the experience and knowledge to have the convincing answers for such problems and to supply the equipment and design the Closed Coke Slurry System for Zero-dust Delayed Coker units.