

How to drive a modern coke cutting system

Dr Wolfgang Paul and Jay Jones describe the features of modern cutting system drives for hoists and drill stem drives (rotary joints) implemented since 2000.

Since 2000 the technology in delayed coking units has changed drastically. Several developments had been carried out in the years before, but only small advancements had been achieved in relation to safety, performance and reliability.

Recently in combination with the development of automatic top and bottom valves, automatic drilling/cutting tools and hoist drivers have high performance cutting systems realised large improvements in safety, performance and reliability.

Basically, the process parameters determine the nature of the coke unit and the decoking system. This will not be investigated, only mechanical aspects of system will be addressed.

Up to the year 2000 projects and orders were based on coke drums with diameters of up to 29ft (8.8m) and heights – flange to flange (FF) of up to 130ft (39.0m).

Presently, there are decoking units under construction with a diameters of 32ft (9.80m) and FF-heights of 150ft (46.0 m). This reflects an increase of 15 per cent in length and 10 per cent in diameter. As the volume increases with the square of the diameter and linear with the height, a larger performance (through put) will be achieved with increasing the diameter rather than the FF-height.

Other factors beside the process parameters like total height of the structure, coke drum strength site specific conditions can play an important role, but these issues will not be considered here.

Around the year 2000, the flow and pressure of the Jet Pump was 1200 gpm@4400psi (272 m³/h@300 bar). As the coke drum size increased there was an increase in jet pump hydraulics to 1400gpm@5000 psi (320m³/h@350 bar).

Only the drivers at the hoist and drill stem drives remained constant, for a while.

See the diagram of the development of coke drums and jet pump flow and pressure from 1980 to 2008. The data is shown as a per cent to reflect the growth over the time. At each time different sizes of pumps and drums have been built, the diagram shows the tendency. The basic data for the calculation are indicated below.

Over decades the hoists and rotary joints have been driven by compressed air with pneumatic motors. Performance was approximately 30HP (22 kW) for the Hoist and 13HP (10kW) for the Rotary Joint (also called Drill Stem Drive, DSD).

There are several installations were hydraulic driven components have been installed in the 1990s, but the majority of installed units remained air driven.

Parallel to the requirements for higher performance other issues needed to be addressed, like reduced noise levels and environmental pollution. As air motors have a high noise level and oil spraying due to lubricated air.

With the further increase in size of drums and jet pumps a general change in hoist drives and drill stem Drives was necessary.

Hydraulic driven components

The hoists and drill stem drives needed to be operated with much higher power levels without increasing the size of the components.

In 2000 Ruhrpumpen developed a modernised hydraulic driven system of hoists and drill stem drives, powered by a Hydraulic Power Unit, especially designed for operation of these components in a coker. The advantages include:

- ❑ Pull force of hoist up to 9900 lbf (45kN).
- ❑ Torque of DSD up to 5500 lbf (7500Nm).
- ❑ Motor-pump drivers are installed redundant in an enclosed shelter.
- ❑ Operation and control is carried out from an operator panel via PLC. This is one of the basic requirements for remote or automatic cutting.

Nevertheless, more piping and installation of hydraulic components on the cutting deck and derrick was necessary.

Electrical driven components

In 2004 Ruhrpumpen developed an electrically driven system for the hoists and drill stem drives. The hoist and DSD motors are driven by variable frequency drives (VFD), with installed redundant VFDs. Units

	Jet Pump Pressure	Jet Pump Flow	Drum dia	Drum FF
year	psig	gpm	ft	ft
1980	3400	1000	26	105
1990	3900	1150	27	115
2000	4550	1200	29	130
2008	5000	1400	32	140

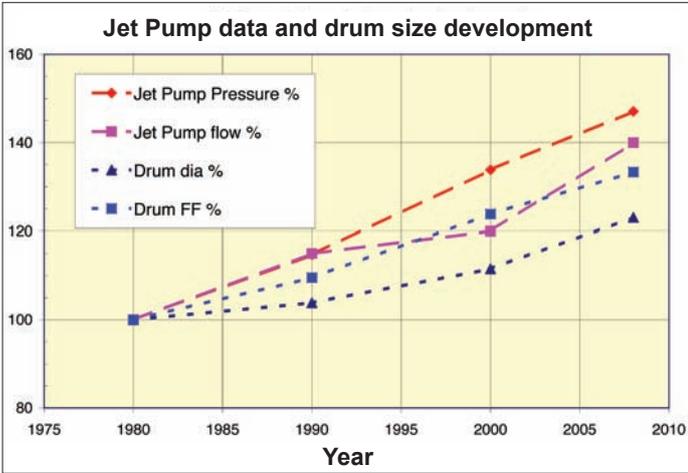


Fig. 1. Jet pump power and drum size development.

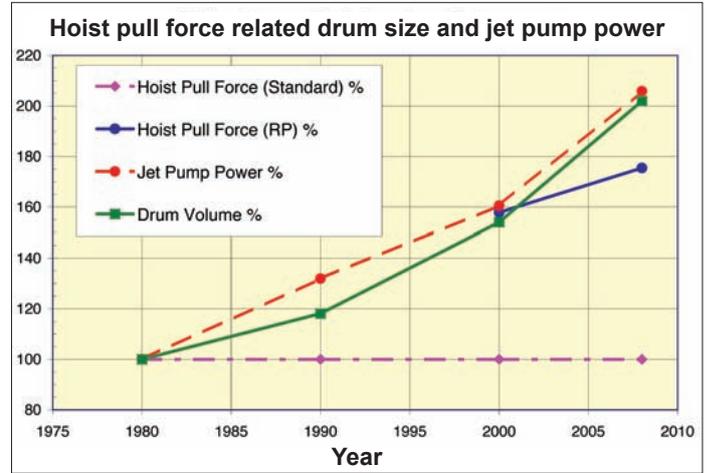


Fig. 2. Hoist pull force related to drum size and jet pump power.

- ▶ can be located in safe or hazardous areas.
- Beside a higher pull force and pull speed the following additional advantages were achieved: reduced installation time and costs; eliminating of hydraulic oil from the cutting deck; full compliance to area classification (ATEX, UL, CSA, GOST); design temperature in a range of -49°F to 113°F (-45°C to 45°C).
- Sizing of the components are related to following considerations:
 - Power requirement of hoist is related to Volume of drums.
 - Weight of cutting equipment increases with height of drum.
 - Weight of cutting equipment increases with drum diameter due to higher pressure.
 - Power requirement of the hoist is congruent to power of jet pump.

- Weight increases with flow and pressure. With the new drive systems following performance is available:
 - Hoist: pull speed.
 - 1st layer: 197ft/min (60m/min)@pull force 10 000lbs (44kN) hyd/11 500lbs electric
 - 4th layer: 229ft/min (70m/min)@pull force 9400lbs (42kN) hyd/ 9980lbs electric
 - DSD: max RPM 15@7500Nm.

Increased coke drum size and resulting jet pump increase in hydraulics, hoist power requirement and increased performance of the pull speed and pull force was necessary.

Hydraulically driven drill stem drives and hoists were already performing successfully to meet the above conditions for several years. The new step was the development of the electrical version which fulfils and exceeds all requirements.

Conclusion

With the increase in size of the coke drums an increase of jet pump power did follow. Until recently (2000) the power of the cutting equipment had not been increased. Ruhrpumpen developed drive systems for decoking hoists and drill stem drives, driven hydraulically or electrically.

The power of these components followed the tendency of the coke drum volume and jet pump power to meet the actual requirements of modern coke cutting systems.

The new features of the cutting system result in a more safe and reliable service as well as in reduced operation time. □

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Figs. 3. and 4. Electrical driven decoking hoist (left hand and right hand version) and electrical driven drill stem drive.