LEWA pumps + systems

HYDROCARBON CONDENSATE

What is hydrocarbon condensate (HCC)?

Hydrocarbon Condensate (HCC) is a by-product of the off- and onshore production of natural gas. Occasionally it is also present in oil production.

Due to its toxic, corrosive, abrasive and partially high-boiling composition the disposal of HCC, especially offshore, is problematic.

Depending on pressure and temperature HCC can be gaseous, liquid or even solid (see table 1)

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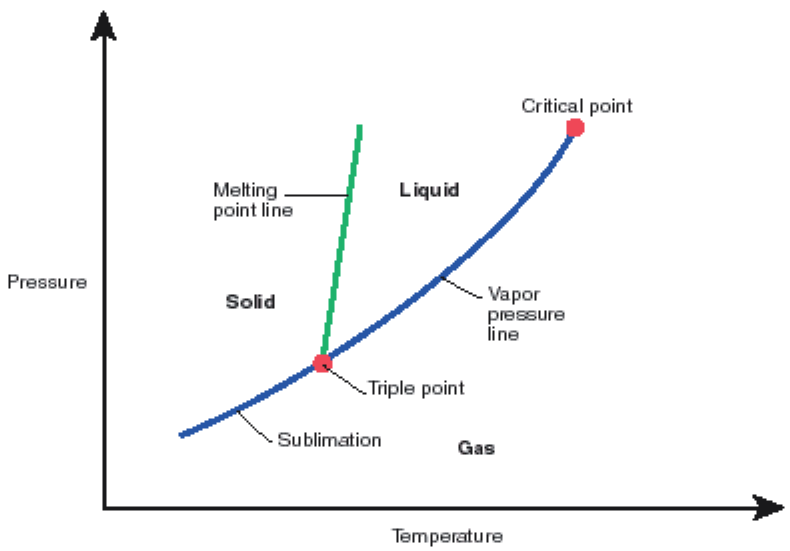

Figure 1: States of aggregation HCC (Hydrocarbon Condensate)

Disposal of HCC

Due to the fact that the main problem arises with the disposal offshore we consider this case in detail. Disposal onshore is not problematic as storage facilities are available, partially the HCCs are also separated and further processed.

Offshore the HCC is separated from the gas and intermediately stored in so-called knock-out drums. Usually the re-injection resp. - for several platforms - the transportation to a central gathering station for re-injection resp. for further transportation onshore and for processing is carried out via the float switches at the knock-out drums. This means that the flow can be somewhat variable (depending on the selection of the pump), however pressure and availability are important aspects. The pumps must withdraw a sufficient volume so that the LSHH of the knock-out drum does not trigger otherwise the production must be stopped.

The different parts of HCCs with their boiling points are shown in table 1.

Additionally the following substances are contained:

- H_2S: corrosive and highly toxic
- CO_2: high vapour pressure, non-lubricating, freezes when decompressed (leakage)
- Mercury: highly toxic and hazardous to water in some gas production places up to 250 ppb
- Water that was also separated from the gas and which is very aggressive resp. corrosive together with H_2S; small fractions of diesel are not dangerous apart from the potential contamination of water.
  Note: water + H_2SO_4 => acid = very corrosive
- Sand particles in HCC (low, normally < 1%), which are highly abrasive at the operating pressures applied of up to 250/300 bar

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Table 1 : Substances contained in HCC

Name	Molecular formula	Melting point	Boiling point	State at 25°C
Methane	CH_4	-183	-164	Gas
Ethane	C_2H_6	-183	-89	Gas
Propane	C_3H_8	-190	-42	Gas
Butane	C_4H_{10}	-138	-0,5	Gas
Pentane	C_5H_{12}	-130	36	Gas
Hexane	C_6H_{14}	-95	69	Gas
Heptane	C_7H_{16}	-91	98	Gas
Octane	C_8H_{18}	-57	125	Gas
Nonane	C_9H_{20}	-51	151	Liquid
Decane	$C_{10}H_{22}$	-30	174	Liquid
Undecane	$C_{11}H_{24}$	-25	196	Liquid
Dodecane	$C_{12}H_{26}$	-10	216	Liquid
Eicosan	$C_{20}H_{42}$	37	343	Liquid
Triacontane	$C_{30}H_{62}$	66	450	Solid

What has to be observed for the pumps to be used?

Due to the mixture of corrosive and abrasive contents the wetted parts must be selected very carefully. Especially the valves, for which **hardness and corrosion** resistance must be brought in line, require particular attention.

As already mentioned, several fractions of HCC are at the boiling point. However, the fraction of high boiling parts is so low that they are of no importance apart from a small reduction of efficiency. The smaller gas portion even reduces the coupling peaks (pressure) of a reciprocating positive displacement pump.

The low fractions (high vapour pressure) and the CO_2 contained result in parts of the HCCs in the knock-out drums being at the vapour pressure and therefore the design of the pipeline as well as the inlet pressure loss of the pump are extremely important in order to prevent cavitation.

The pump supplier must be able to determine and calculate the following points:

- Pipeline design
- Nominal diameter of pipeline
- Strainer data
- Pressure drop and mesh size i.e. strainer area, double strainer with switch-over differential pressure display / signal
- Shut-off valves with full area
- Pulsation dampers and their location
- Position of the knock-out drum: possibly 2 decks above the pump so that with a normal deck height of 3 m a suction height of 6m is given

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The customer is not able to do this as he does not have the pump data.

Here it must be considered that even multiplex pumps (Triplex) can generate high suction and discharge acceleration due to the high compressibility of HCCs and the resulting low efficiency. In this case it might be required to use booster pumps , which have a suction accelerator and can operate at a suction height of 30-50 cm (1-2 ft).

Why should diaphragm metering (process) pumps be used?

Plunger pumps are less expensive initially, however, especially for the usually intermittent operation of HCC installations, have major disadvantages. The only technical advantage is the somewhat lower NPSHr (Net Positive Suction Head required). **This however is compensated without problems by LEWA's new M900 diaphragm pump heads.**

Disadvantages of plunger pumps

- Intermittent operation leads to a temporary stop of the pump
- The salt spray offshore as well as the corrosive fractions in HCC lead to pitting corrosion at the plunger (electrolytic corrosion) and hence to leakage. This is a problem, especially for the stand-by pump
- Sometimes coated plungers are used, the coating peels off when the surface is damaged. This results in sharp edges, which destroy the plunger packing within a very short period of time leading to massive leakage (danger of fire)
- The abrasive parts (sand, solid HCCs, possibly hydrate) as well as gaseous parts result in high wear and partially in heat build-up (gassing off) in the packing chamber. This rapidly reduces the packing service life
- Packing maintenance is difficult, special knowledge is required. Incorrect packing arrangement / packing tensioning reduces the service life extremely
- There are also cases, where the plunger and the packing of the plunger pump, which was switched to stand-by, were damaged at start-up already to an extent that after a short period of time emergency switch-off had to be carried out. This leads to production loss
- Due to the toxic parts leakages are hazardous to the health and hence extremely dangerous, the corrosive parts cause local corrosion in the periphery of the package
- High packing friction means high losses. It must be absolutely considered that the platform must be shut-down in case the disposal pumps cannot be operated and the overfill protection of the knock-out drum is triggered. This might result in losses of several hundred thousands Euro a day

Advantages of the LEWA diaphragm pump

- Absolutely resistant PTFE diaphragm
- Diaphragm pump body consists of resistant solid material
- Optimal valve design due to the modular system
- Safe sandwich diaphragm with monitoring. No leakages of toxic and environmentally hazardous substances into the atmosphere
- Quick and easy diaphragm replacement, no special knowledge required. A service life of over 16 000h is normal
- No wetted plunger seal
- Low drive power due to negligible friction loss in the sealing area - plunger works in the oil bath
- Optimal service life at lowest maintenance costs: Depending on the pump size the diaphragm pump can pay off within 2 - 3 years just by the low spare parts costs. If down times and production losses are taken into account, there is no alternative to the process diaphragm pump
- The stand-by pump can be started-up without any problems and it is a huge advantage that it can remain switched into the system under suction or even discharge pressure because LEWA's diaphragm support allows long downtimes under pressure without any problems

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Glossary:

Knock-out drum:	container into which the HCC is separated.
VPH:	Volatile Petroleum HCC, with 6-10 C including benzine, paint thinner
TEH:	Total Extractable HCCs
LEPH:	Light Extractable Petroleum Hydrocarbon
HEPH:	Heavy Extractable Petroleum Hydrocarbon

(Important for further processing only.)

Other abbreviations

DRO:	diesel range organics (Approx. = HEPH)
EPA 1664:	gravimetric method for hexane extractable material
GRO:	gasoline range (Approx. = LEPH)
HEM:	n-Hexane extractable material
MAH:	monocyclic aromatic hydrocarbons i.e. BTEX, STYRENE
Oil & Grease:	solvent (usually hexane) defined extractable material
PHC:	petroleum hydrocarbons in soil
SGT-HEM:	silica gel treated n-hexane extractable material
TPH:	total petroleum hydrocarbons
VPH:	volatile petroleum hydrocarbons, nC_{10}-nC_{32} mostly diesel
VH + EPH:	kerosene, jet fuel, weathered gasoline
VHw:	volatile hydrocarbons in water nC_6-nC_{10}
VPH:	volatile petroleum hydrocarbons
nC_6-nC_{10}:	unweathered gasoline, mineral spirits, paint thinners

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