Determining Hydrocarbon Dew Point (HCDP) improves amine scrubber performance

The GC8000 Process Gas Chromatograph continues Yokogawa's long tradition of process GC excellence with a design that takes the best of emerging technologies yet continues to utilize proven reliable components.
By integrating GC8000 with hydrocarbon dew point (HCDP) calculator which embeds the phase behavior modeling package Multiflash™* on edge computer, HCDP is calculated in real-time.

*Multiflash™ is comprehensive PVT and physical properties package.

Gas Chromatograph GC8000

Customer Concerns

The natural gas compositions vary depending on the reservoir locations, and they often contain undesirable substances which cause corrosion to the facility and pipeline. Gas processing plant plays a critical role in removing the acid gas Hydrogen Sulfide (H_2S) and Carbon Dioxide (CO_2), dehydration, and hydrocarbon recovery. Amine gas treating in gas processing, also known as amine scrubber shown on Fig.1, removes H_2S and CO_2.
Pure amine does not form stable foam. However, if liquid hydrocarbon is dissolved in amine solution, it reduces surface tension and increases foaming tendency with coexisting gas bubble.
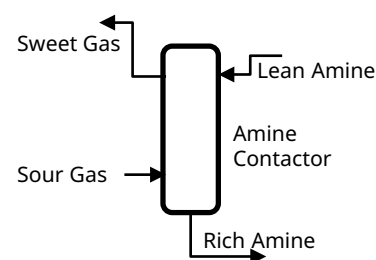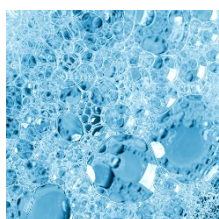
Fig.1 Amine gas scrubber

Amine foaming increases the operating costs and reduces treating efficiency with the following behavior:
- **Sudden volume and pressure increased by the foam in the contactor disturbs the control.**
- **Foaming reduces the contact area between sour gas and amine, thus efficiency of absorbing acid gas is reduced.**
- **Antifoaming agents require the extra cost and operation.**

It is well known that lowering temperature of amine column increases H_2S absorption although liquid hydrocarbon appears while lowering temperature. The challenge of the amine gas scrubber is to optimize the scrubber performance by controlling inlet lean amine stream temperature. Determining the hydrocarbon dew point (HCDP) of inlet gas enables the avoidance of the condensation of the hydrocarbon in contactor. There are two methods available for detecting the HCDP. One is experimental method using chilled mirror and the other is theoretical method using Equation of State (EOS) calculation. Chilled mirror uses the actual sensors and it requires the maintenance, calibration and has installation restrictions when gas treatment is under high pressure.

Phase change depends on inlet gas composition, pressure and temperature as shown on Fig.2. EOS complexity increases especially when BTEX (Benzene, Toluene, Ethylbenzene, Xylene) is included. Thus, EOS calculation is often done by upper layer server, and it makes the system configuration and network more complicated. Yokogawa's HCDP calculator which embeds the phase modeling package Multiflash™* on high performance edge controller enables the real-time calculation on-site.
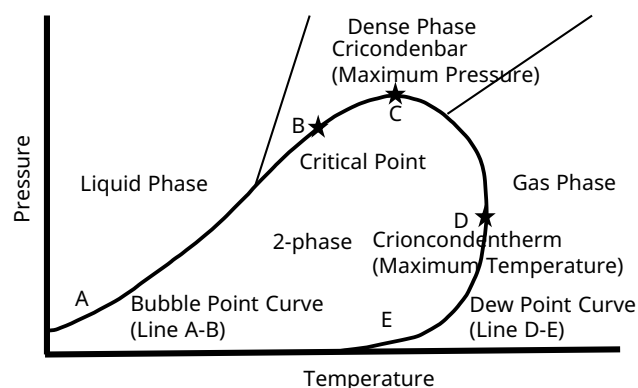
Fig.2 Example of gas, liquid, and dense phase of natural gas (refer to AGA Report No. 8 Part1)

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Solutions

Yokogawa provides HCDP calculator as a part of amine scrubber control.
Fig. 3 shows the system architecture.

Process gas chromatograph analyzes the gas composition and sends composition and pressure to HCDP calculator with field communication. HCDP calculator calculates the HCDP temperature under the current gas composition and pressure and sends it to DCS via analogue and/or digital signal, even Modbus TCP/IP protocol.
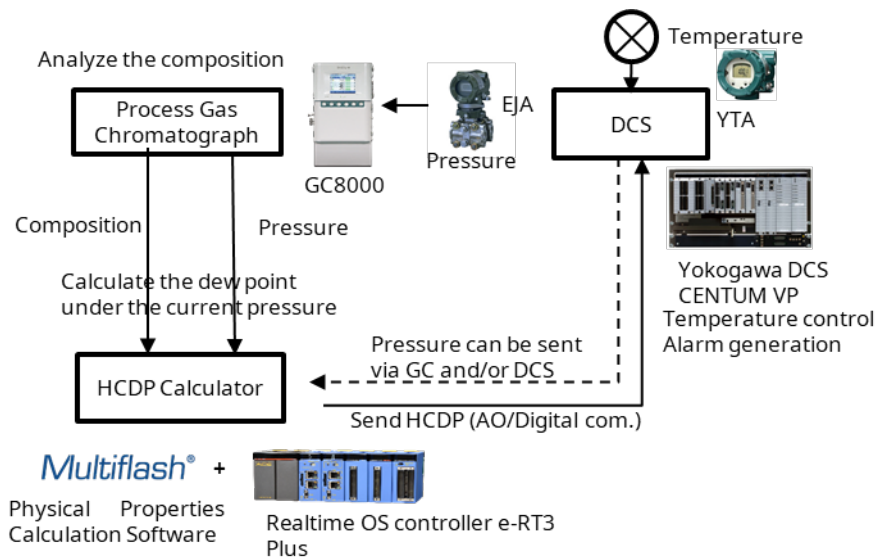

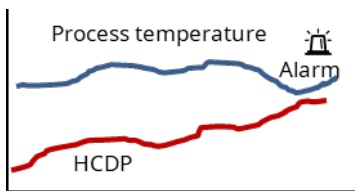Fig.3 System architecture

Fig.4 Process temperature and HCDP

DCS generates the alarm when the process temperature is within the threshold of HCDP to warn the possibility of amine foaming as shown on Fig. 4.
DCS controls the contactor temperature by cooling down lean amine temperature.
Operations become more effective using this system:
- **Operator can control the lean amine temperature to avoid the hydrocarbon condensation**
- **Operator can monitor pressure and volume change more carefully**
- **Operator can prepare the antifoaming agents.**

Conclusion

Yokogawa provides the HCDP solution with the following features:

Advanced calculation capability
Calculation of HCDP of gas composed of C12+ and BTEX is more complicated than typical natural gas (C1 to C10). Few physical properties software packages support EOS to enable this calculation. Multiflash™ has an extensive calculation capability to cover a wide range of gas compositions.

Fast calculation speed
Edge controller powered by real-time OS ensures fast response time for complex EOS calculations.

Add-on solution
HCDP calculator can be added on existing GC/DCS systems. Analog output is also available for an easier DCS interface.

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