Determination of hydrate formation temperature at LP flare header

Hooman Tabaraei
Specialist Process Engineer (MIChemE, CEng)

Does anyone have come across to estimation of hydrate formation temperature at flare header, downstream of RO, and consequently determination of MEOH required for hydrate formation depression at flare header. HYSYS and UNISIM both predicts hydrate formation temperature at pressure above 330kpa, and below that no hydrate formation predict. And only indicate to "ice formation first" messgage. UNISIM Support team recommend to change hydrate formation model to another type, like "assume free water" in order to find hydrate formation temperature. But I think we need to select water dew point temperature at flare header pressure (which might be less than 330kpa) instead of hydrate formation temperature, if it's more. I appreciate to have your point of views.

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Mojtaba Habibi
Process Engineer at Petroleum Engineering and Development Company (PEDEC)
Top Contributor

Mojtaba

Dear Hooman,

I have discussed the similar topic earlier and you can read the details at:

http://lnkd.in/VBgEhf

You read the topic and let me know if hydrate formation is a real concern for flare network?

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Hooman Tabaraei
Specialist Process Engineer (MIChemE, CEng)

Hooman

Dear Mojtaba,
Thanks for your notice. In your topic the situation of hydrate formation at flare header, downstream of BDV or PSV has been investigated well. And in this topic, I'm opening this question that how to estimate the accurate MEOH injection rate to prevent solidification at flare header. Today I received a meesage from UNISIM support team, that they suggested to select 32F(0degc) as freezing point temperature in case of appearing "ice formation first".
I agree that due to high velocity at flare header hydrate formation will not happen most probably, but in sections with low velocity, or stagnant points, hydrate (or ice) might be observed.

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S M Kumar
Process Design Consultant
Top Contributor

S M

Hydrate in low pressure (LP) flare? What kind of upstream P&T are considered?

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Hooman Tabaraei
Specialist Process Engineer (MIChemE, CEng)

Hooman

We want to estimate MEOH requirement for preventing hydrate formation at downstream of BDV's which are routed to LP flare header.

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Mojtaba Habibi
Process Engineer at Petroleum Engineering and Development Company (PEDEC)
Top Contributor

Mojtaba

Dear Hooman,

Could you please clarify what do you mean by "sectons with low velocity"? As you know Mach. number of 0.5 or higher is one of the design constrains for flare network which will results in high relieving velocities. For cases with back pressure limitation the velocity may be low but I think this mostly cover LP flare systems to which the relieving sources with low set pressure values are connected and temperature drop may not be so high.

Anyway engineering issues all the times are subjected to this question that how conservative we want to be at design. While I may not be noticed to hydrate formation concern for flare network, others may be concerned about that.

I noticed you focus on MEOH injection. There are many doubts in my mind with this option. Below are some of them:

1. MEOH is costly. Is this method economically justified in comparison with other methods like heat tracing which is recommended by SHELL company practice?

2. Different BDV/PSV have different set pressures. If based on hydrate formation study, for example 50 numbers of the sources are concerned with hydrate, then how to design pumping system with 50 different set points?

3. How fast is this chemical injection from storage tank to PSV/BDV? Do we need some jockey pumps to make a pressurised network of the MEOH chemical similar to fire water case such that to reduce this time?

4. When and how to inject MEOH?

5. How reliable is this MEOH injection system?

6. How accurate/predictable is the hydrate temperature and dosage rate of MEOH?

I think by implementing some modifications like segregation of wet and dry relieving sources, avoiding very small size tail pipe and sub-headers and heat tracing of the sources with leakage concern, hydrate formation concern at flare network can be minimized to ALARP.

Best,
Mojtaba

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Vinay Singhal
Process Engineering Manager at McDermott International Inc.

Vinay

Mojtaba has raised quite a few relevant questions pertaining to providing a MeOH injection for prevention of hydrates build-up in flare systems. Yes, hydrate/ice formation downstream of PSVs & BDVs is always a concern and should be checked. But, for mitigation measures, I suggest you read SHELL DEP 80.45.10.10. As mentioned earlier, due to fast velocities, accumulation of hydrates during an actual relief scenario is not considered credible. SHELL is more concerned about a leaking PSV or a passing BDV, which could result is slow build-up of ice/hydrate in the outlet side valve seat or small bore piping. Heat tracing a section of inlet/outlet relief piping is recommended. MEOH injection is not the solution due to operational issues mentioned in Mojtaba's reply above. On a similar note, I came across a FEED done by one of the reputable Engineering companies from Melbourne, which asked for corrosion inhibitor injection into the flare header due to high CO2 content in the relief gas from some sources. In fact the FEED went on to recommend "Detailed Engineering should establish means of corrosion inhibitor injection when the following flare relief sources get activated"

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Hooman Tabaraei
Specialist Process Engineer (MIChemE, CEng)

Hooman

Dear Mojtaba,
At our current project, we've considered several injection points for MEOH at diiferent locations,

such as well haeds, discharge side of after cooler, and downstream of those BDV's /PSV's which hydrate formation will happen. MEOH is injected during start-up at air cooler discharge side, and wellheads pileline, and during depresuring of BDV's. MEOH injection rate have been determined based on depression of hydrate formation temperature down to min. operating temperature during start-up or depressuring. This estimation is based on the worst scenario that operator need to inject th maximum required MEOH into plant. And since (at current project) hydrate formation scenarios can be considered during winter, in a short period, MEOH injection in order to prevent hydrate formation will be economical alternative in compared with heat tracing option.

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Mojtaba Habibi
Process Engineer at Petroleum Engineering and Development Company (PEDEC)
Top Contributor

Mojtaba

Dear Hooman,

For this current project you mentioned, is there any operational demand for MEOH injection into flare network other than start-up case? If so, could you please describe the sequence of MEOH injection?

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Reza Modanloo
Senior Process Engineer /Open to new opportunities
Top Contributor

Reza

Dear Hooman,
you can ignore injection for Hydrate inhibition regarding Mojtaba explanations if you assume that hydrate nucleates are not stable in the downstream of PSV due to high velocity of relief stream.but many companies consider the possibility of hydrate formation in the flare network and inject MEG or MEOH at upstream of PSV or BDV to prevent hydrate formation.you can use following procedure to calculate the MEOH injection rate:
1- Do flash operation from PSV set pressure down to flare back pressure in HYSYS across a valve for instance to determine the minimum relief stream temperature in flare side.(T1)

2-calculate the hydrate formation temperature at P=back pressure by hysys or handbooks data(T2)

3- calculate depression temperature = T2-T1

4- use Hammer Schmidts equation to determine required rate of MEOH injection

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Reza Modanloo
Senior Process Engineer /Open to new opportunities
Top Contributor

Reza

Dear Hooman,
it is a good idea if you send required data of one the injection points to my e-mail address so that i can calculate the rate of MEOH upstream of flare as a case study.as you know required data are as follow:
stream composition,set pressure and temperature,relief flow rate,flare back pressure

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Hooman Tabaraei
Specialist Process Engineer (MIChemE, CEng)

Hooman

Dear Mojtaba/Reza,
Thanks for your notice - required MEOH to inject at each point has been estimated based on depression of hydrate formation temperature (at corresponding pressure) down to min. gas temperature or freezing point temperature, whichever is less. And as we have several injection points to inject MEOH, we need to go through operation of plant in order to estimate the maximum requirement of MEOH for injection. And certainly MEOH pump capacity is selected as per worst case that maximum MEOH rate is required, however this pump is assumed to come on stream temporary during start-up or depressurizing.

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Reza Modanloo
Senior Process Engineer /Open to new opportunities
Top Contributor

Reza

Dear Hooman
could you please explain for me what you mean of corresponding temperature and how you

determined min temperature of gas and freezing point?

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Jeremy Goldbloom
Oil & Energy Professional

I would comment that the reliability of a methanol injection system during plant shutdown is questionable. As regards velocities, there is a purge requirement which will set a minimum velocity when nothing is relieving. See Appendix 4.6 in "Relief Systems Handbook" by C.E. Parry. If needed I could scan the page and email it.

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Hooman Tabaraei
Specialist Process Engineer (MIChemE, CEng)

Dear Reza/Jeremy,
- "Corresponding pressure" means flare header pressure which is less than 330kpa. And in this case which HYSYS/UNISIM predict no hydration and indicate to "ice formation first", freezing point (equivalent with 0 degc) is assumed instead of hydrate formation temperature.
- I appreciate you send me scaned sheet. my email : htabaraei@yahoo.com

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Devsing Patil
PROCESS ENGINEER at TEBODIN & PARTNER LLC

Hooman,
1.Methanol injection system could not works as RV release intermittent and sudden.
2. If you could not avoid hydrate formation , header temp tracing is the one of the method rather than Injection of chemical fluid like Methanol.
3.Which package you are referring unisim ?

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Reza Modanloo
Senior Process Engineer /Open to new opportunities
Top Contributor

Dear Hooman.
Did you determine the freezing point (ice formation) by hysys? could you give me some advices how to do it by Hysys?

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Reza Modanloo
Senior Process Engineer /Open to new opportunities
Top Contributor

Dear Devsing,
Why MEOH injection is not suitable for intermittent and sudden release? in this case which kind of chemical is ok ?could you give me some advice on that and any reference if possible?

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Jeremy Goldbloom
Oil & Energy Professional

If you can devise a completely reliable system for delivery of ANY CHEMICAL during an emergency shutdown, you deserve a Nobel prize. Be serious!

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Hooman Tabaraei
Specialist Process Engineer (MIChemE, CEng)

Dears,
In current project,MEOH is injected into different locations such as upstream of air coolers, and wellhead gas lift/injection, in order to prevent of hydrate formation that might be occured during start-up or depressurizing of compressor loop, and wellhead gas injection/lift - at winter case. In all cases MEOH is injected temporary for a short period, and it's more economical in compared with heat tracing which should be always on stream, even during normal operation. And secondly capital investment for wiring of long pipeline with electrical or steam tracing is not a good solution in our case, however for a short distance, tracing is more reasonable alternative rather than MEOH injection.
0degc as freezing point at ATM is assumption of UNISIM support team, also Aspen Flarenet assume ice formation at 0degc and below it.
Thanks for your notice

Mojtaba Habibi
Process Engineer at Petroleum Engineering and Development Company (PEDEC)
Top Contributor

Mojtaba

Dear Hooman,

1. Besides intermittent start-up and depressurization cases you mentioned, there is another case which refers to leaking PSV/BDV. Based on SHELL DEP, they only care about leakage case and for other cases like depressurization because of high relieving velocities they ignore about hydrate formation concern. Heat tracing can prevent PSV/BDV body freezing or blockage due to leakage. I am not sure how chemical injection can help in this regard for leaking PSV/BDV.

2. The most seroius concern for chemical injection method is reliability and operational philosophy. We do not know when BDV/PSV will pop. Then which logic is considered for chemical injection sequence?

3. About cost issue for chemical injection method we need complete package including storage, pumping, instrumentation and drainage facilities. Some of the chemicals need N2 blanketing. So all of these required facilities in comparison with heat tracing option may or may not be cheaper option.

Reza Modanloo
Senior Process Engineer /Open to new opportunities
Top Contributor

Reza

Dear Hooman,
Thanks for your explanations. i am interested to know how you determined the minimum temperature to calculate the depression.one method,that i always use, is crossing the gas flow from a valve in HYSYS from set pressure down to flare back pressure.when gas pressure reduced to back pressure its temperature falls also across the valve.
did you use the same method to determine the minimum temperature of gas in flare side?

Reza Modanloo
Senior Process Engineer /Open to new opportunities
Top Contributor

Reza

Dear Mojtaba,

Thanks very much for the information you gave us.I think decision about if we use chemical injection or forget about it depends on many factors such as Client demand, designer company policy and economical issues. could you please send the SHELL DEP criterion for me? my e-mail address is: reza_modanlou@yahoo.com
Regards
Reza

Hooman Tabaraei
Specialist Process Engineer (MIChemE, CEng)

Hooman

Reza,
First min. temperature of gas (after depressuring, or during start-up) was estimated, then depression(=hydrate formation temp - min. temperature of gas) calculated. then MEOH requirement for prevention of hydrate formation as per hammerschmidt, or nielson corrolations determined. In our assignment, we had many scenarios for different locations, and in above I've explained simplified.

Reza Modanloo
Senior Process Engineer /Open to new opportunities
Top Contributor

Reza

Dear Hooman,
How do you determined the gas minimum temperature?
this is what i like to know exactly.

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