Hydrate Formation Concern for Flare Network

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

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Dear Friends,

I would like to start this topic to share our experiences about hydrate formation concern within flare network.

I have seen some engineering companies that study this concern for flare network using softwares like Hysys, Promax and Flarenet and in case of any hydrate prediction they consider hydrate prevention methods like methanol injection into flare network or heat tracing of flare lines.

My 2 cents on this matter:

1. Although from theoritical point of view this concern may be predicted but in reality I have not seen any real incident which is reported on this matter.

2. Flare network lines are designed for high mach no. values (e.g, 0.5-0.7) and this flared gas with great velocities will sweep any hydrate nucleate (if any) that may form.

3. Relief from pressure relieving devices are intermittent and short term in nature while hydrate formation and growth needs permanent addition of water and hydrocarbon. So enough inventory will not be available for hydrate growth.

4. Flare network lines can be considered as heat sink in comparison with site environmental conditions and so most of the time these flare lines are warm enough to melt any hydrate nucleate that may form.

5. Even if the Client or Engineer decide to consider methanol injection method it seems that there are lots of doubts in reliable operation of this system. How and when this system will act to cope against hydrate formation? Flare network is the last layer of protection for a plant and is "passive" in nature so how this methanol injection system which is "active" in nature can protect this network?

6. Heat traced lines also may not be effective due to great velocities of flared gas streams and also low heat transfer coefficient of the gas phase.

Let me know your idea and experiences.

All The Best,
Mojtaba

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Ajay

Ajay Sharma
Senior Process Engineer at Petrofac

Your experience on the subject is correct. As even with the lowest flow rate the velocity of vapour will be very high so it will not allow any hydrate formation. Moreover, methanol injection on flare system is of no help as it has to be automatic on demand which means shall be highly reliable (if it all hydrate formation is a concern).

In my opinion, we should never consider hydrate formation in flare header as a credible scenario. If at all to consider that shall be for operational flaring case.

Hope this clarifies your query.

regards,

ajay sharma

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Mojtaba

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Here is SHELL company experience on the discussed subject: (Reference: DEP 80.45.10.10-Gen.)

"The Joule-Thomson effect, occurring across the relief valve when relieving, may lower the temperature to within the hydrate or ice formation region. Due to the high velocities, there will likely be no problem of relief valve blockage at relieving conditions.

Valve blockages could occur, however, due to small leaks across the relief valve seat. To prevent this blockage, heat tracing/insulation shall be provided around the relief valves that can be affected by hydrates and freezing."

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S M

S M Kumar
Process Design Consultant
Top Contributor

My 2 cents worth:

1. I have not seen any real incident but have read reports about external icing and internal blockage, due to suspected hydrate formation in continuous dump lines – PCV dumping gas on compressor trip or flowline/ trunkline depressurization.

2. Velocities are low when PSV's leak or pass. All plant valves leak. This is indicated in the DEP you quote.

3. No comments

4. While rest of the downstream header and pipes are indeed a large sink, the tail pipe immediately after the PSV/PCV has a small thermal mass. It can chill down fast. You may verify it with an excel sheet, with each row looking at cooling over a finite period, say initially 0.1 sec and later 0.5 to 1 sec. In high pressure services, sizes of PSV and their tail pipes are small. Such small tail pipes can easily block, unless you take care to add an expander and make tail pipes larger 4 – 6" to minimize hydrate build-up risk.

5. Methanol injection "provision" is better than have nothing - if you look at loss of production. They help in continuous dump services.

6. Heat tracing helps. Higher gas velocities lead to high heat transfer coefts. Even at 10% sonic, hc is high. Calculate for yourself. High velocities tend to keep the metal temperature close to gas temperature. Heat tracing performance is not dependent on gas coeft.; nor its purpose to heat the gas. It maintains metal temperature constant above hydrate formation temperature thereby melting any hydrates without allowing them to build.

Caution: This aspect is missed by process engineers. The PSV or PCV body can conduct cold upstream, thereby reducing the temperature of the high pressure fluid and hence may result in downstream temperature lower than predicted by process calcs/ commercial software. All programs predict unreliable values; Imperial college, UK's Blowdown model claims a 0.5C accuracy in prediction based on field verification. In critical services, better to have a run by them, rather than take things for granted

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ANJARIA HITESHKUMAR M., Saeid R. Mofrad and 2 others like this

Mojtaba

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

Dear S M Kumar,

1. I could not understand the case you have mentioned at item 1 of your explanation is a contineous flaring case or intermittent? Could you please clarify this matter?

2. About item 5:
Why methanol should be injected while we know (and as explained by SHELL DEP), hydrate fomation is unlikely?
Suppose we decide to consider methanol injection. Then: how and when this system should be activated? Keeping in mind that each PSV, PCV and BDV has its own set point based on pressure, how to design the system to cover these different set pressures? We do not know when the PSV will pop so how methanol should be injected for the PSV? How to rely on the reliability of this system?

Let me know your idea.

All The Best,
Mojtaba

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S M

S M Kumar
Process Design Consultant
Top Contributor

Sorry Mojtaba, that my comment is not clear.
1. Both continuous and intermittent (of short duration). Continuous as in flowline/ trunkline depressurization. This could be intermittent too, say for a short duration, PCV dumping gas on compressor trip, allowing the tail pipe to chill below hydrate formation. Once icing occurs on piping outside surface, it forms a barrier to atmospheric air to heat the cold pipe.
5. Usually a provision is made for manual initiation of methanol injection for PCVs only. It is activated manually if flow is for s sustained period. PSV and BDVs do not require any methanol injection provision; only heat traced outlets on a case to case basis. Their outlets can be made larger 4 to 6" and piped directly into a large flare header or sub-header so as to blow away any potential hydrates.

Difficult to give any general rule. Go by your plant experience. A flare header in a hot country at 35 Deg C is differnt from another at -10 C with wind chill.

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Mojtaba

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

Dear S M Kumar,

For the first item:
1. If this is contineous line connected to flare then I also agree that hydrate formation concern is valid and this case is similar to process lines that at some points we inject hydrate inhibitor.

1. If this is pipeline depressurization, this also can be a valid concern because of long depressurization time (I have seen in some cases it takes some days to manually depressurize the pipeline).

1. If this is PCV then let me know based on those reports that you have read earlier, the case involves frezzing of the PCV or tail pipe blockage? For PCV freezing this can be a concern because PCV even at closed position will have contineous leakage to flare. Also PCV in comparison with depressurizing lines has this drawback that for depressurizing line the RO downstream of BDV can prevent the BDV from freezing but for PCV this should act as combination of BDV+RO.

For the second item:
1. Can we use heat tracing instead of hydrate inhibitor injection?

2. For the design that you have described (manual initiation of methanol injection for PCVs), how the system is designed? Suppose I have 5 PCVs with 5 different upstream pressures. Then how the injection system shoud cover all of them?

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S M

S M Kumar
Process Design Consultant
Top Contributor

1. PCV tail pipe blocking. Have not heard about PCV seat freezing. [A BDV opening for depressurization is a must. PCV opening or not opening is not that critical. It is usually backed by PAHH and PSV. Usually high pressure gas is dehydrated; hydrate should not be an issue. Wellhead gas can be at high pressure but I see less these days!]

2. As indicated in Shell DEP, go for heat tracing the valve body and tail pipe - for high pressure

WET gas. Don't have to do that for dry gas. If tailpipe is small make it large with an expander - to prevent hydrate build-up and pipe it to blow away any hydrates into the larger flare header. You may have to make the tail pipe larger any way, to avoid high velocity linked vibration and shear issues. Hope you are aware of and are conducting AIV/ FIV Studies (acoustic induced and flow induced vibrations) and have read Safety Alerts about how high pressure PCV tail pipes have sheared or broken right inside the plant at their junction to flare header causing fire in plant.]

Usually permamnent methanol injection connection is given upstream of PCVs that are expected to be in service for a long duration. Others are given only a blanked off injection quill. These are hooked up to a pumps as and when demanded. For your 5 PCVs, the nature of service (sustained or short term, dry or wet and upstream pressure) should tell you what to do.

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