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Closed Drain Drum Heater

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

Dears,

At this topic I would like to discuss about heater design considerations for closed drain drum (sump).

First issue for closed drain drum is that how to study about the requirement of heater? and how to specify the duty?

As I checked some of the projects I have seen different designs.

1. Some of the designers consider no heater for CDD.

2. Some of them spcify the heater duty based on minimum ambient temperature. For example the heater shall be sized to heat the cold liquid up to 5C (while the minimum ambient temperature is 0C)

3. Some of the designers specify heater duty with time basis. For example heater should vaporize the liquid content of CDD within 1 hour or half an hour.

4. Some of the designers consider concerns due to fluid nature like wax formation.

5. As you know before drainage, the equipment should be depressurized. So the liquid will reach very low temperatures after cold depressurization. Should we consider a case that due to any fault or failure, this cold liquid is drained into closed drain network and finally reach to CDD and cause icing/hydrate formation? If so is this a sizing case for CDD heater?

Could you please shed some lights which method to be used?

Second issue is about installation of heater inside of CDD. This is common requirement that heater should be immersed below low low liquid level. Based on your experiece how much should be the value of low low liquid level to ensure this requirement?

Many thanks for your time.

Best,
Mojtaba

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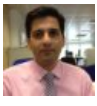

Saeid R. Mofrad
Principal Process Engineer at Petrofac (P.E.)
Top Contributor

1. Coil is required if:

- The difference between fluid pour point and minimum ambient temperature is less than 10°C
- fluid freezes at minimum ambient temperature
- fluid solidifies (wax) at minimum ambient temperature
- fluid precipitates at undesired location at minimum ambient temperature
- hydrate is formed at minimum ambient temperature
- fluid viscosity increase at minimum ambient temperature impeding equipment operation

• vessel content is going to be vaporized to flare as there is no disposal system

2. If you specify the reason for hating coil, then you will be able to realize which sizing method is appropriate. For example:

• For winterization purpose:

 If a temperature control system is used to maintain the liquid temperature above specific temperature, so heating coil should be sized to make up heat loss considering liquid at desired temperature and surrounding to minimum ambient temp. Q = UA (Tdesired – Tambient)
 If heater operates on on-off control or operator intervention Q = m Cp (Ton –Toff)/Time + UA (Ton – Tambient)
This scheme is not usually used for winterization purpose.

• If the heater is to vaporize the content, you have to specify if it is batch operation or continuous:

 For batch operation, you have to specify the period in which vaporization can occur, then it is Q = m [Cp (Tboiling –Tinitial) + latent heat] /Time+ heat loss
Tinitial can be minimum ambient temp as conservative assumption.
Appropriate Time can be assumed depending on process requirement.
 For continuous operation Q = W [Cp (Tboiling –Tinlet) + latent heat] + heat loss

• Etc.

Liquid level setting depends on size of heater but minimum 700-800 mm is required to install an electrical heater. Minimum liquid level for steam tube bundle has to be specified based on thermal rating but steam coil definitely needs much lower LLL.
Electrical heater has to be fully submerged otherwise skin temperature increases causing heater failure. The same requirement is applied for steam to ensure required heat is supplied to liquid as the main purpose is to heat up the liquid not gas!

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Mojtaba Habibi likes this

Mojtaba

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

Dear Saeid,

As per your explanation your basis for the worst temperature is minimum ambient temperature. How about items 5 of my first post?
As you know before drainage, the equipment should be depressurized. So the liquid will reach very low temperatures after cold depressurization. Should we consider a case that due to any fault or failure, this cold liquid is drained into closed drain network and finally reach to CDD and cause icing/hydrate formation? If so is this a sizing case for CDD heater?

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Mojtaba

Mojtaba Habibi
Process Engineer at Petroleum Engineering and Development Company (PEDEC)
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Another case in my mind:

As you know CDD floats on LP flare via locked open vent line. In case of cold depressurization of plant, the cold relieving streams may reach CDD depends on plant layout and cause icing/hydrate formation at CDD. Is this a sizing case for CDD heater?

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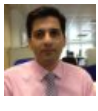

Saeid R. Mofrad
Principal Process Engineer at Petrofac (P.E.)
Top Contributor

From material viewpoint, closed drain system can be designed to handle cold liquid drain from process vessel after depressuring depending on project drain philosophy.

But I don't think that intentional or unintentional drainage of this cold liquid will cause hydrate formation in closed drain vessel because:

> If the fluid temperature is already lower than hydrate temp, hydrate formation will take place in process vessel itself.
> Furthermore, normally drain system (being at higher temp) acts as heat source so liquid temperature at closed drain drum inlet is higher than process vessel.

About the possibility of hydrate formation due to flare cold gas reverse flow into closed drain drum

when it is floated with flare via LO valve, I think it is possible. Then heater may be sized for that.

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Mojtaba Habibi likes this

Mojtaba

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

Dear Saeid,

Many thanks for your valuable comments for CDD heater sizing cases.

As you know for CDD pumps based on cause and effect, the pumps will be tripped upon very low liquid level. For this case do we need to shutdown the CDD heater as well?

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Alireza

Alireza Ranjbarmehr
Senior Concept/Process Engineer at Wood Group- CCC (Oman Branch)

Mojtaba, Saied
As saied said; all the time there is some certain amount of liquid available in higher temperature inside CDD. Possibility of hydrate/ice formation is rare even in float via LO valve. (inside the CDD is all the time kept warm normally 5~10°C higher than pour point and this makes the vessel body warm as well). Saied mentioned all possible items for "Design" of the heater in worst conditions. Heater itself all the time is equipped with temperature control even in steam or electrical for retaining the temperature inside CDD. So what does shuting down of heater mean in this instance?
In my previous project experience, the only cause of using electrical was the absence of steam in unit.

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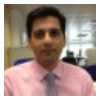

Saeid R. Mofrad
Principal Process Engineer at Petrofac (P.E.)
Top Contributor

Electrical heater is automatically switched off when heater surface temperature goes high or liquid level falls below top of heater bundle (say LLL) to prevent damage to heater.

Moreover, there should be a low level permission to start for electrical heater.

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Alireza Ranjbarmehr likes this

Mojtaba

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

Dear Alireza,

1. About design case for CDD heater:

You have mentioned that "inside the CDD is all the time kept warm normally 5~10°C higher than pour point and this makes the vessel body warm as well".

This is similar to the case described by Saeid:
"If a temperature control system is used to maintain the liquid temperature above specific temperature, so heating coil should be sized to make up heat loss considering liquid at desired temperature and surrounding to minimum ambient temp. Q = UA (Tdesired – Tambient) "

How the CDD heater can control the temperature if not already designed based on low temperature resultant from cold depressurization?

1. About CDD heater type selection issue:

It was in my mind as secondary issue to ask and I intended to discuss whenever heater design case issue is finalized. Fortunately this is raised by you and now we can discuss about this issue. As I found even if steam is available at plant, there is not too much proved working experiences with such a steam heater for CDD whose steam trap is at an elevated position. For more information please refer to following link:

http://www.cheresources.com/invision/topic/11160-electrical-or-steam-heater-for-closed-drain-drum/

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

Mojtaba

Dear Saeid,

About your above mentioned point:

"Electrical heater is automatically switched off when heater surface temperature goes high or liquid level falls below top of heater bundle (say LLL) to prevent damage to heater.

Moreover, there should be a low level permission to start for electrical heater. "

As you know very low liquid level inside of the drum will trip the heater and heater start will not be possible unless the shutdown cause is cleared from the DCS system using ESD reset. Moreover as you mentioned usually high temperature trip protection is considered for heater. So do we need low level permissive in excess of these protections?

Best,
Mojtaba

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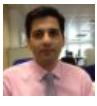

Saeid R. Mofrad
Principal Process Engineer
Top Contributor

I guess my previous post needs some explanations. I did not mean that we need both high temp and low liquid level trips. Single temp trip will protect the heater against high temp (whether it is because of control failure, low level, or etc).

if the high temp trip is because of causes other than low liquid level, the operator will be able to switch on the heater after resetting the ESD. In this case, liquid level permissive (to start) will have no effect on the heater restart (assuming that the liquid level has not dropped below low level after heater trip).

if the high temp trip is because of low liquid level, the operator will not be able to switch on the heater after resetting the ESD because the liquid level permissive (to start) will not let the start single reach the heater. If you don't like this logic , you can have auto-reset provision for low liquid level permissive loop so that the start permission is automatically granted to operator when the liquid builds up above low level set point.

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

Mojtaba

Dear Saeid,

If the high temp trip is because of low liquid level, and planned cause and effect is such that to trip the heater upon very low liquid level then with or without such liquid level permissive operator will not be able to start the heater unless the liquid level reach to a value higher than very low level trip set point. So could you please shed some light on the necessity of such permissive logic?

Best,
Mojtaba

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