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RISKS OF ACCUMULATED SULFUR IN SULFUR RECOVERY UNITS

By: Ellen Ticheler-Tienstra, Anne van Warners, Rien van Grinsven and Sander Kobussen of Jacobs Comprimo® Sulfur Solutions

Abstract

While recovering sulfur in an SRU depends on condensation of sulfur, its unintended condensation and accumulation can present problems. The paper analyses areas where this may be expected and presents case histories of sulfur build-up in SRU equipment, such as waste heat boilers, reheaters, sulfur condensers and coalescers. The risks involved in accumulation of sulfur are discussed, both for the operation of Claus plants and for the operation of SUPERCLAUS® plants, for which liquid sulfur may pose extra risks. Ways are discussed to prevent accumulation and minimize the risks.
This paper focuses on the most common type of SRU configurations, not on sub-dewpoint type SRUs.

Introduction

From time to time operational issues in an SRU are related to accumulation of liquid sulfur. These issues can be experienced in any SRU but operating experience over the past 25 years has shown that SUPERCLAUS® and EUROCLAUS® installations are sensitive to liquid sulfur accumulation, as will be discussed below.

In the modified Claus process, sulfur is produced both in the thermal stage and in the catalytic stages. Since the Claus reaction is a chemical equilibrium, the production of sulfur is inhibited if sulfur vapor is already present in the process gas. Therefore a sulfur condenser is generally used to condense and remove the produced sulfur and ensure continued conversion to sulfur in subsequent stage(s). As a general rule the sulfur production is progressing as shown in table 1. This also shows the relative contribution of each stage to the total sulfur production.

Sulfur Production (%)	Thermal stage	First catalytic stage	Second catalytic stage	Third catalytic stage	SUPERCLAUS® stage	Coalescer
3 stage Claus	60.2	29.1	6.1	0.9	2.8	0.2
2 stage Claus	60.2	28.9	5.9	-	3.8	0.2

This table is based on a typical refinery feed of 75 vol.% H_2S, 5 vol.% NH_3, 10 vol.% CO_2, 10% H_2O, 0.3 vol.% C_2H_6 and almost complete removal of sulfur vapor from the process stream. The condensers are not removing all of the sulfur, it is sufficient to stay above the sulfur dew point in the following catalytic stage. In the sub-dewpoint processes (CBA, Sulfreen, MCRC) there is some deliberate condensation of sulfur to below the dewpoint to force the Claus equilibrium closer to completion.

Fire risk of accumulated liquid sulfur

Principles of a sulfur fire

The best known risk of accumulated liquid sulfur is that of a sulfur fire. For this to happen, air (or better: oxygen) has to be present in sufficiently high concentrations (>10%). At lower concentrations of free oxygen in the process gas the sulfur will be oxidized to SO_2 thereby generating extra heat of oxidation. A sulfur fire can also lead to corrosion that is higher than normally experienced.

Besides sulfur vapor (from liquid sulfur) and oxygen in sufficiently high concentrations (>10 vol.%) there has to be an ignition source. The following sources have been identified:

- No additional source, when the temperature in the process at that point is above the auto-ignition temperature of sulfur. The auto ignition temperature most often mentioned is 230°C but values ranging from 190°C to 261°C have been reported, possibly linked to the sulfur particle size.
- Pyrophoric iron sulfide (FeS), when exposed to air (oxygen) will ignite a sulfur/air mixture
- Static electricity generated by liquid sulfur agitation. Sulfur, being one of the best electric insulating liquids known, and having a high dielectric constant can easily generate enough static electricity to cause a spark ignition

Oxygen concentration during normal SRU operation

During normal operation of a Claus unit with a good quality main burner hardly any oxygen will slip from the main combustion chamber to the catalytic stages, therefore the process gas does not contain free oxygen and there is no risk of a sulfur fire. During normal operation (the risk of) oxygen ingress arises from air instead of nitrogen purges on the main burner, fuel gas fired direct reheaters (inline burners) and in the SUPERCLAUS® process, where air is introduced to selectively oxidize H_2S to elemental sulfur. The oxygen concentrations in these cases are limited and will not lead to sulfur fires.

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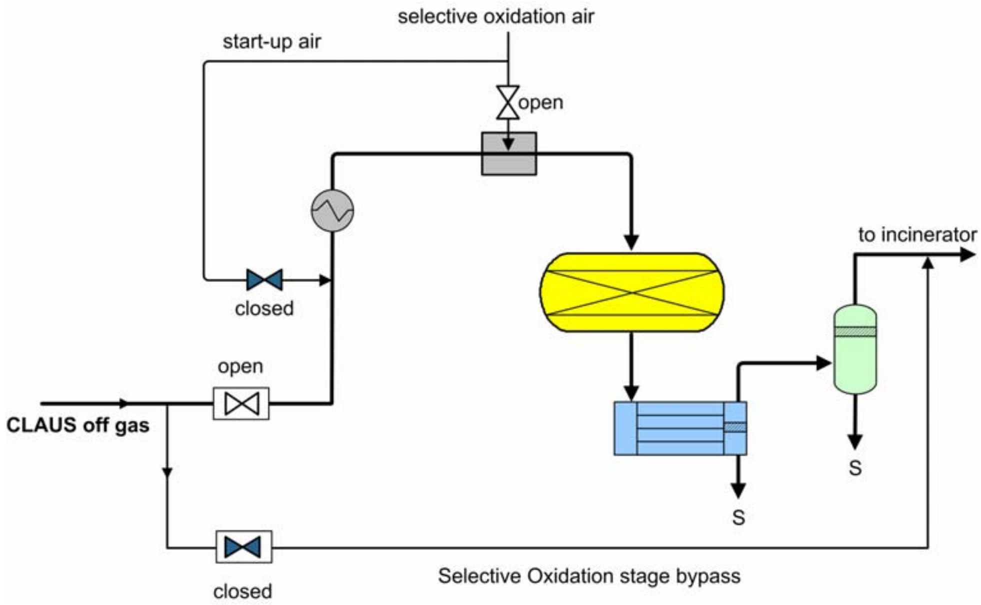


In case of a SUPERCLAUS® or EUROCLAUS® installation, oxygen concentration is designed to be just enough to convert H_2S and keep the catalyst in an oxidized state. In the reactor outlet there should be just 0.5% to 1.0% oxygen present.

Oxygen concentration during abnormal SRU operation

The risk of a sulfur fire increases as soon as higher concentrations of oxygen enter the system. This happens most often when the main burner is in the start-up phase and/or operated with fuel gas, e.g. during heating up, hot standby or during taking the unit out of operation, when the burner is operated not substoichiometrically, but with excess air.

In the first two modes of operation (heating up with sulfur in the unit and hot standby) this is due to wrong setting of the air to fuel gas ratio. This can occur easily, when the main burner is not operated with a fuel gas of constant composition (preferably natural gas), but with a fuel gas of varying composition (and Mol. Weight, which leads to wrong fuel gas flow metering). A fuel gas analyzer (e.g. Wobbe index meter) could be installed to compensate for fluctuations in fuel gas composition and air demand.

In the last mode of operation (taking the unit out of operation for maintenance), it is the intention to gradually convert FeS to Fe_2O_3 in a controlled way by increasing the oxygen slip from the main burner.

Oxygen concentration during abnormal SUPERCLAUS® operation

In the selective oxidation stage of a SUPERCLAUS® plant, higher concentrations of oxygen can be present during heating up or shutting down or during a bypass of the selective oxidation stage.
A bypass of the selective oxidation stage occurs on high temperature in the catalyst bed or on high inlet H_2S concentration and protects the selective oxidation stage during upsets, preventing too high temperatures in the reactor. In such a case the reactor temperature is maintained by purging the reactor with air. This also keeps the catalyst under oxidizing conditions and prevents ingress from sulfur containing tail gas via the back-end of the selective oxidation stage.
So, during a bypass the atmosphere in the selective oxidation stage contains 20% oxygen. When this atmosphere comes in contact with any accumulated sulfur in the piping or equipment (reheater, condenser, coalescer) then there is an increased risk of fire.

As to liquid sulfur, it is important to note that the selective oxidation catalyst does not retain liquid sulfur in its pores, unlike Claus catalyst. So sulfur in the selective oxidation catalyst does not contribute to the risk of a sulfur fire.

An obvious result of a sulfur fire is damage to equipment. Condenser tubes and mist pads are especially vulnerable. Sometimes the fire is limited, either by available sulfur or oxygen, and will give a noticeably higher temperature but no damage. Note however, that in every sulfur fire not only SO_2 but also SO_3/sulfuric acid will be produced. Sulfuric acid can eventually lead to extensive corrosion damage in lines and equipment.

Other effects of accumulated liquid sulfur

Besides the risk of a sulfur fire there are other effects of accumulation of sulfur.
When the level of stagnant sulfur has risen high enough, it will impede the flow of process gas and cause pressure drops forcing lower gas feed rates. A sudden limitation to the capacity or an increased main burner inlet pressure may be a sign of sulfur accumulation. Yet a normal inlet pressure is no guarantee that there is no sulfur accumulation.

If there is a pool of liquid sulfur, the flow of process gas can entrain liquid sulfur, carrying it downstream in the form of mist or even slugs of liquid sulfur. An illustration of this effect is the upward flow of raindrops on the windscreen of a car above a certain speed.
In downstream equipment, the sulfur can be knocked out and will accumulate at low points in the unit. This results in a pool of liquid sulfur, when the sulfur cannot be drained properly.
In this respect it is relevant to mention that agitation of liquid sulfur by the process gas flow can generate static electricity and act as an ignition source, as described before.

Another effect of entrained sulfur is obstruction of lines or demister pads. Entrained sulfur has been found to plug instrument lines and even tail gas analyzers. Also the efficiency of demister pads can be compromised by accumulation of sulfur in the pad. Furthermore, a nowadays not unimportant side-effect of entrained sulfur reaching the incinerator is a higher stack SO_2 emission.

Finally, when an installation containing liquid sulfur is allowed to cool, the sulfur will solidify and mechanically removing the solid sulfur in lines and equipment can be very difficult and time consuming.

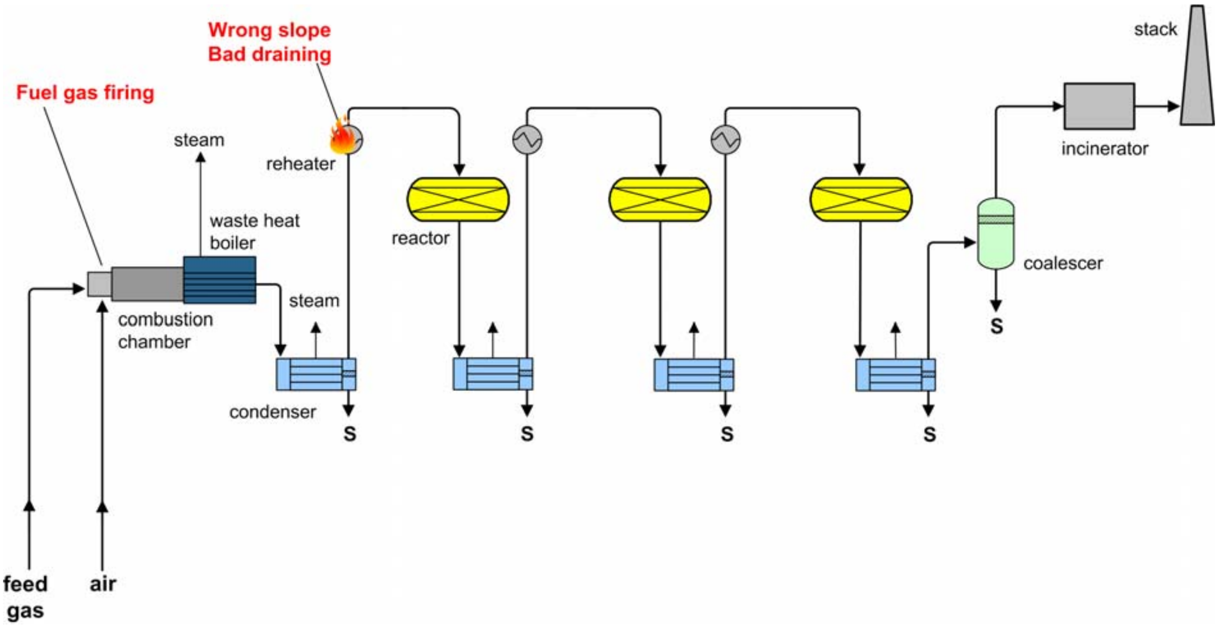
Case histories

It is believed that sulfur accumulation as described in this paper occurs widely, but is often not identified or recognized in a Claus unit. In the case histories below, several incidents in the Claus stages and in the selective oxidation stage of SUPERCLAUS® installations are described. It will however be clear that this type of incidents is in no way unique for SUPERCLAUS®.

Case 1: Refinery application, 3 stage Claus unit

Description:
The unit was operating fine but because of a small instrument problem the acid gas was shut down and the unit was operated in hot standby mode. After approx. 30 minutes a sulfur fire was seen in the first reheater. This is a general SRU case.

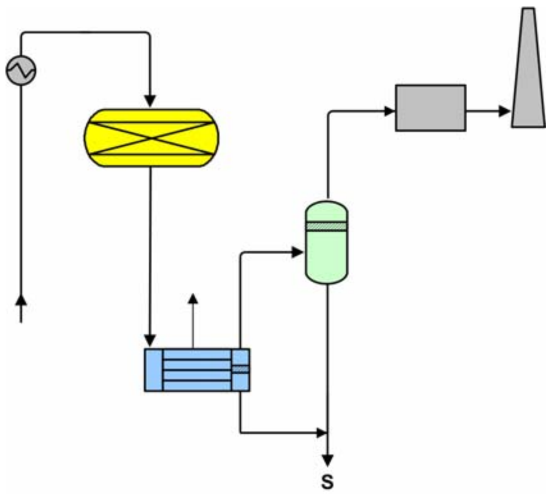
Cause:
Sulfur had accumulated in the first reheater and could not drain because of a wrong slope of the reheater. Also the sliding strips in the reheater shell prevented proper draining of sulfur. In hot standby mode, the air/fuel gas ratio was too high and consequently air contacted the accumulated sulfur. The ignition source is not known, it could be either pyrophoric iron sulfide or hot reheater tubes. Initial oxidation of sulfur by air may have increased the temperature in the reheater to above the auto ignition temperature.
On the first signs of a fire, the operator reacted by admitting more air to the unit, thereby increasing the fire.



Case 2: Natural gas application, 2 stage Claus unit with SUPERCLAUS® tail gas treating

Description:
The unit had been in operation for a year without problems. During a maintenance shutdown the coalescer was found full of solid sulfur reaching up to halfway the inlet nozzle. Also the sulfur outlet of the last condenser was found to be full of solid sulfur. No sulfur fire was experienced, but the solid sulfur had to be removed mechanically. This is a general SRU case.

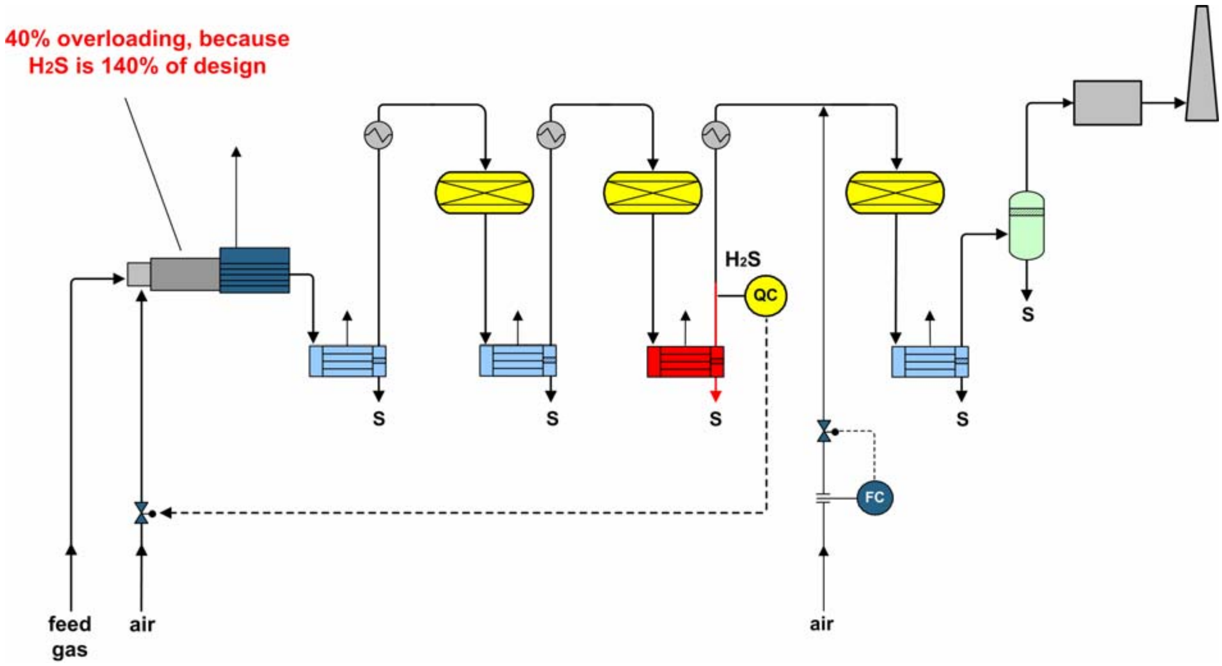
Cause:
The rundowns of the last condenser and the coalescer were combined without a seal in between. During operation there was a suspicion of a full coalescer because vibrations were noticed in the coalescer vessel. Also there was more SO_2 in the stack than in the coalescer outlet, indicating sulfur entrainment from the coalescer to the incinerator. Staff checked the coalescer and observed gas flow from an opening in the coalescer sulfur rundown line. From this they wrongly concluded that the coalescer vessel was empty.
Later it was found that the combined rundown was partially blocked and the condenser outlet was completely blocked.



Case 3: Natural gas application, 2 stage Claus unit with SUPERCLAUS® tail gas treating

Description:
During normal operation the tail gas analyzer signal was seen to fall away periodically. Also the sulfur flowing out of the last Claus condenser was coming in surges and vibrations were noticed. The plant appeared to operate at nominal acid gas flow. This is a general SRU case.

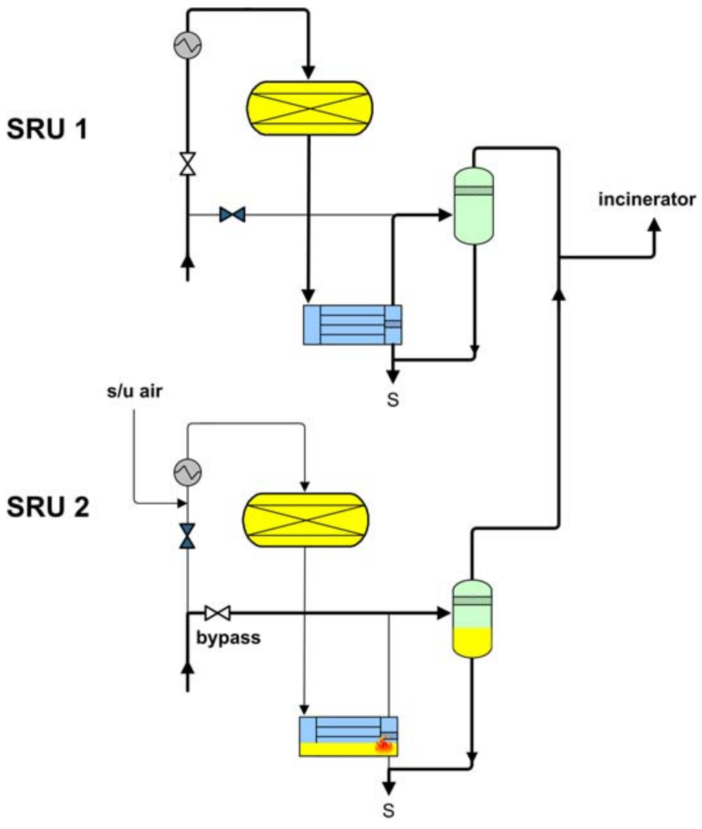
Cause:
It was found that, although the acid gas input flow rate was as per design, the H_2S content of the acid gas was higher, by 40%. This caused overloading of the Claus condensers resulting in entrainment of sulfur and plugging of the downstream tail gas analyzer. Because of this the analyzer read-out became unreliable.



Case 4: Refinery application, two Claus units, each with 2 Claus stages and SUPERCLAUS® tail gas treating, with common incinerator and stack

Description:
One of the two SRUs had been in operation, while the other unit was cold. Also the SUPERCLAUS® stage of the standby unit was cold and was not being purged. Since the outlet lines of the two units were connected, tail gases from the hot unit could diffuse back into the cold unit.
After one year, the cold Claus unit was started up and was operating in Claus mode for 3 weeks while the SUPERCLAUS® unit was still cold. When after this period attempts were made to heat up the SUPERCLAUS® reactor with hot start up air, it was found that the SUPERCLAUS® stage was blocked. After heating up the SUPERCLAUS® condenser with steam the air started to flow and a sulfur fire occurred in the condenser and outlet line.

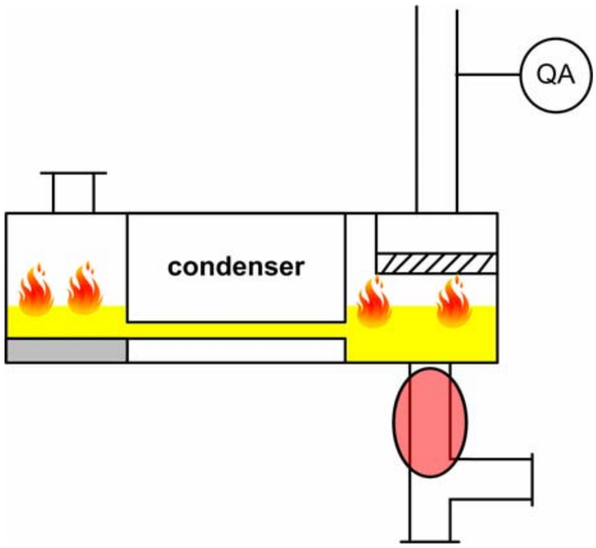
Cause:
Two separate but linked causes were identified. The first one was that corrosive gases and sulfur vapor diffused back from the hot unit (SRU 1) to the cold unit (SRU 2), causing corrosion and forming pyrophoric iron sulfide in the outlet line and outlet channel of the cold condenser; also the cold demister pad was plugged with sulfur.
The second cause was accumulation of sulfur in SRU 2 during the 3 weeks of operation in Claus mode, due to plugging of the run down line from the coalescer of SRU 2. At some point in time the liquid sulfur was flowing back to the cold part of SRU 2 via the connected run down lines and filling part of the condenser up to the inlet channel. When the condenser of SRU 2 was heated up, the hot start up air contacted the liquid sulfur. In itself that could not start a fire because the air was not hot enough, the fire did not start in the inlet channel. But when the air contacted pyrophoric iron sulfide in the outlet channel, ignition occurred.
The sulfur fire damaged the demister pad and part of the outlet line. Sulfuric acid produced by the fire caused secondary corrosion damage.



Case 5: Natural gas application, 3 stage Claus unit with SUPERCLAUS® tail gas treating

Description:
Within a period of two weeks, two sulfur fires were experienced in the SUPERCLAUS® condenser. The SRU had been in operation for eight years without incidents.
The fires occurred when the Selective Oxidation stage was bypassed and (oxidation) air was allowed through the SUPERCLAUS® bed. The fire resulted in some severe damage/corrosion to the internal of condenser.

Cause:
It was found that the sulfur lock was blocked by debris and that sulfur had accumulated in the last condenser (SUPERCLAUS® condenser), even flowing through the condenser tubes to the inlet channel. Upon bypassing the SUPERCLAUS® reactor, hot undiluted air at a temperature of 252°C contacted the liquid sulfur in the inlet channel. Since the auto-ignition temperature of liquid sulfur in pure air (20% O_2) is 230°C a sulfur fire resulted. As is commonly seen, the fire spread from the inlet channel through the condenser into the outlet channel and caused severe damage of the condenser.



Case 6: Refinery application, three Claus stages and a EUROCLAUS® tail gas treating

Description:
During normal operation the tail gas analyzer signal was seen to fall away periodically for 5 to 10 minutes. To investigate this, the SUPERCLAUS® stage was bypassed for a longer period. After 30 minutes a sulfur fire started, but it was at that moment not noticed by the DCS operator. To maintain the temperature in the SUPERCLAUS® stage extra air was added upstream of the reheater, thereby intensifying the fire.

Cause:
Because of a failure of the catalyst grid, catalyst particles were carried through the final Claus condenser and accumulated in the sulfur lock, causing a blockage. Sulfur accumulated and entrained sulfur was carried over to the SUPERCLAUS® reheater by the process gas flow. There the sulfur mist was knocked out and accumulated in the reheater inlet line. The sulfur could not flow back to the condenser because the SUPERCLAUS® inlet valve had been closed. Oxidation air, used to purge the SUPERCLAUS® reactor during the period of bypass, slowly diffused upstream until the O_2 concentration was high enough to cause a fire. The exact ignition source is not known, it could be either pyrophoric iron sulfide or hot SUPERCLAUS® reheater tubes. Interestingly, the steam temperature in the reheater was probably not high enough to cause ignition, but the initial oxidation of sulfur by air may have increased the temperature in the reheater to above the auto ignition temperature.
The sulfur fire damaged the reheater tube bundle and the reheater inlet line.

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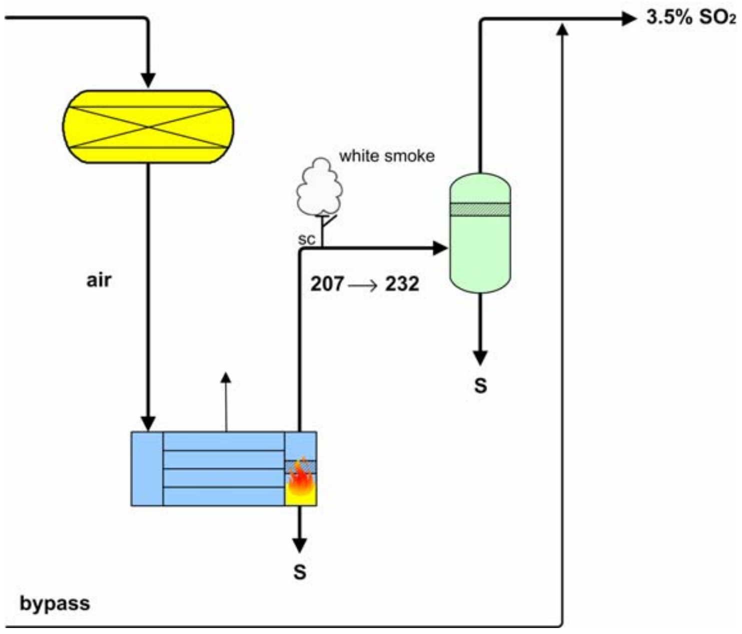
Case 7: Natural gas application, 2 stage Claus unit with SUPERCLAUS® tail gas treating

Description:
The unit had been running normally but the SUPERCLAUS® condenser outlet temperature was higher than normal. During SUPERCLAUS® bypass operation, air was introduced to keep the unit warm and ready for normal SUPERCLAUS® operation. The condenser outlet temperature was seen to rise from 207 to 232ºC in 20 minutes. Analysis of the coalescer outlet gas showed an SO_2 content of 3.5 vol.%, indicating a sulfur fire. When the sample (Strahman) valve in the condenser gas outlet line was opened white smoke was escaping. It was concluded that accumulated sulfur in the SUPERCLAUS® condenser outlet channel was burning. Upon closing the air supply block valve, the fire extinguished and normal operation could be resumed.

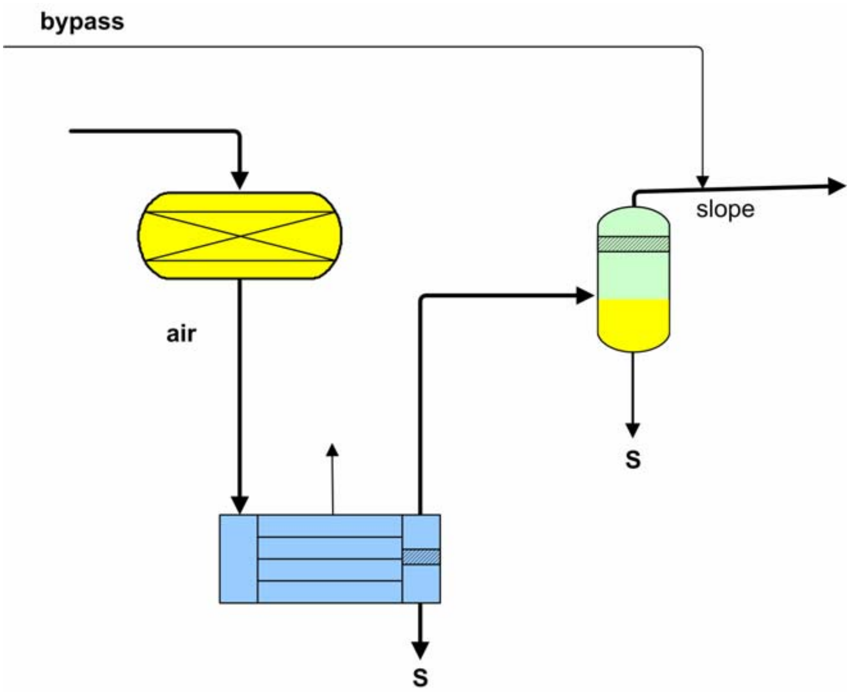
Cause:
Partial plugging of the SUPERCLAUS® condenser rundown line had caused liquid sulfur to accumulate in the condenser outlet channel. Because of malfunctioning of the pressure control the condenser temperature had risen to above 170ºC, thereby making the sulfur more viscous and making it harder to drain properly. Also the control valve in the oxidation air line was leaking and causing some oxidation of sulfur. Upon admitting more air, a moderate sulfur fire started, that could be easily extinguished. No damage to the equipment was observed.



Case 8: Refinery application, three Claus stages and a EUROCLAUS® tail gas treating

Description:
A few hours after the SUPERCLAUS® stage was taken into operation, the rundown valve of the coalescer was opened and, unexpectedly, a large flow of sulfur appeared in the funnel that lasted for more than a quarter of an hour. The SUPERCLAUS® condenser rundown had been opened just before and had shown only one minute of large sulfur flow. Apparently sulfur had accumulated in the coalescer. No damage was seen.

Cause:
The bypass line ties in on top of the gas outlet line of the coalescer, close to the coalescer. From the tie in point the gas outlet line slopes back to the coalescer, so part of the condensed sulfur in the bypass line will end up in the coalescer on gravity flow. The SRU had been in Claus mode for approx. 4 months. Apart from condensed sulfur flowing back, also heavy entrainment from the last Claus condenser may have contributed to the large amount of sulfur in the coalescer. Apparently the last Claus condenser had been operating with a plugged sulfur rundown for some time.
A lesson learned is to always take the coalescer rundown in operation and to expect some sulfur flow from it. Accumulation could have caused a sulfur fire if pyrophoric material had come in contact with the sulfur.



Classification by causes

The most obvious cases of liquid sulfur accumulation are seen when the rundown of sulfur from the unit is restricted.

- A common cause is blockage by catalyst dust or debris. Therefore catalyst loading should be done in such a way that little dust is produced and dust must always be removed during loading. After loading dust should be blown out and the reactor below the grid should be inspected and cleaned. In one example it was found that catalyst had been discharged through the lock, the sulfur rundown line and all the way down into the sulfur collection vessel.
  It should be noted that dust or debris can also combine with sulfur and turn into a form of 'sulfur concrete'. In this state the sulfur will be immobilized and can lead to a fire when favored by the other conditions (air, ignition).
- Another problem is malfunction of tracing or jacketing. In such cases often the stream trap is found to be not working properly, either by poor design, fouling or mechanical defect.
- Blockage can also be caused by wrongly designed outlet lines, e.g. not taking into account the high viscosity that can be expected at temperatures over 158°C. This effect is aggravated further downstream the SRU, where the lower H_2S concentration in liquid sulfur causes a higher viscosity.
- An obvious cause, but still seen sometimes is wrong sloping or routing of lines. If not done properly, sulfur may accumulate in the bottom of equipment or in pockets. As an example, we sometimes observe condensed sulfur in the WHB outlet, where it is not supposed to be according to the designs.

Other cases are those where sulfur accumulates after having been supplied by some means of transport, such as:

- Diffusion of sulfur vapor from a hot place to a cold place
- Knock out of entrained sulfur (mist, slugs)
- Overflow of liquid sulfur from one unit to another connected unit via connected rundowns or connected tail gas lines.

Classification by equipment

Another classification of the cases can be made according to the equipment involved.

Condensers

Plugging of the rundown will lead to flooding of the condenser with liquid sulfur, starting in the outlet channels and the lower tubes. But also in the inlet channel liquid sulfur will accumulate. It is good engineering practice to prevent accumulation of liquid sulfur by making the bottom of the inlet channel flush with the lower condenser tubes. Most practical is to make a concrete floor in the inlet channel.

One might consider that accumulation of sulfur in a condenser can be detected via the pressure drop over the condenser or via the total pressure drop over the SRU. This method is not straightforward because there may be several other causes for an increase in pressure drop, besides flooding of tubes (such as fouled demister, increased throughput etc.). Furthermore it has been found that sometimes hardly any increase in pressure drop is noticed. Even if the sulfur rundown is completely blocked and the condenser is filling up, this will not become noticeable because a considerable percentage of tubes has to be blocked for this. Also liquid sulfur appears to be easily entrained with the gas to the next stage.

One could consider to install a thermocouple with alarm in the inlet channel of the condenser, measuring the temperature just above the concrete layer at the bottom of the inlet channel. In case liquid sulfur is present a lower temperature will be measured, so checking the temperature behavior might help making sure there is no accumulation.

Demister pads

Demisters are often applied in condensers and coalescers. Demisters consist of a large area of thin stainless steel wires Over time, pads may collect sulfur that combines with dust and turns into a form of 'sulfur concrete'. In this state it will stay in the pad and can lead to a fire when favored by the other conditions (air, ignition). Such a fire is enhanced by the large surface area in the pad.
This is one of the explanations for mysteriously disappearing demister pads.

Reheaters

Several cases of fire in reheater inlet lines have been seen. In all these cases, entrained sulfur from an upstream condenser was carried with the process gas over to the reheater, where the mist was knocked out and collected in the inlet line. In some cases sulfur could not drain because of a wrong slope. Also the sliding strips or baffles in the reheater shell may prevent proper draining of sulfur, so proper draining holes should be designed.

Coalescers

Although coalescers are designed to collect sulfur, the outlets can easily become plugged since the nominal sulfur flow coming from a coalescer is so small. Despite enlarged jacketing at the bottom of the coalescer, we have seen quite some cases of unexpectedly filled coalescers.

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Recommended operational procedure

Flush test
To detect partial plugging of rundown lines, locks and funnels the flush test is an excellent tool. It is recommend to do this test preferably every shift but at least every day. If this procedure is carried out consistently a partial sulfur blockage will be detected in an early stage, so that no liquid sulfur build-up can take place. Also by this procedure partial plugging may be flushed out before it completely blocks the line.

The test is done by closing the run down line and let a head of sulfur build up. On reopening, the operator observes the flow of sulfur in the look box (or sight glass) and a large flow of sulfur should be seen.
If the sulfur is only flowing as normal then there is a partial plugging. In such a case the flush test is repeated with the waiting time doubled, before reopening. This may help clean the condenser run-down line by flushing with a large flow. When this is not successful, the partial blockage is removed by rodding or by steam pressure.
Nowadays looking glasses have become in use more widely instead of the open look boxes. The gush of flowing sulfur can also be seen with properly dimensioned looking glasses, since during normal operation the flow only partly fills the glass. It may take some experience to judge the relative increase in flow based on the time that the glass stays filled.

Test details
The flush test has to be carried out for each separate sulfur run-down line, one after the other.
The test is done from back to front, so it starts with the coalescer. The hand valve in the coalescer rundown is closed for two hours, as the sulfur production of this lock is marginal. In case the coalescer and the last condenser have a common lock, the condenser run down valve should be closed after 1.5 hours, and waited for 30 minutes to proceed. Then the coalescer rundown is opened and it is checked whether sulfur is flowing.
If there is no flow or a small flow, the procedure is repeated with an interval of 4 hours. In the mean time all steam traps of this rundown line should be checked to confirm that the heating is functioning. When no sulfur is running the run down line should be unplugged.
Next the last condenser is checked. After 10 minutes the line is opened and a gush of sulfur should be seen.
The procedure is repeated for the other locks. For the third sulfur condenser a time of 10 minutes is advised, for the second condenser 5 minutes and the same for the first condenser, for units with a capacity of 100 t/d and more. For smaller units the times can be increased in ratio to the sulfur production capacity.

The time to close the valve depends on the expected sulfur production in the vessel (condenser/coalescer) and is summarized in the following table.

To prevent cold sections of steam jacketing, check at regular intervals with a lump of solid sulfur whether the steam traps are so hot that the solid sulfur is melting.

	Thermal stage	First catalytic stage	Second catalytic stage	Third catalytic stage	SUPERCLAUS® stage	Coalescer
3 stage Claus	5 minutes	5 minutes	10 minutes	10 minutes	10 minutes	2 hours
2 stage Claus	5 minutes	5 minutes	10 minutes	-	10 minutes	2 hours

Cleaning sulfur boots
One of the reasons for a (partial) plugging could be the accumulation of solids (sulfur concrete, catalyst particles, scaling) in the sulfur boot at the outlet of the sulfur condenser. The sulfur boots should be checked to see if they are clean, this should be done more frequently after initial start-up and on a regular basis later on. These boots protect the locks from plugging with solids. When the boot is full with solids the dirt will end up in the bottom of the sulfur lock and the lock has to be cleaned also, which is a far more extensive operation. When there are indications that a sulfur rundown line is blocked, the blockage may be cleared by rodding. To enable rodding the sulfur run-down line is provided with crosses. Alternatively LP steam can be connected to the top of the sulfur seal, first with the upstream rundown valve open. The steam should flow back to the vessel and small vibrations should be noticeable from the steam bubbling through the sulfur filled line. When the upstream line has been cleared the upstream valve can be closed to do a new flush test to check the line is free of restrictions.

Lessons learned
Reviewing the cases that have been presented we can draw up some guidelines to prevent accumulation of sulfur.

Expect sulfur to accumulate in every vessel, including reheaters. This should be taken into account when designing and sloping the lines.
Design equipment such that sulfur cannot accumulate and is always freely draining away from the equipment.
Keep every part of an installation hot, even when that part is not actually in operation, to prevent condensation and solidification at cold spots.
Identify overloading by looking at the total sulfur quantity being produced, so consider not only the acid gas feed rate but also the H_2S content.

Use the flush test to detect sulfur accumulation in condensers and coalescer.
Always maintain a positive purge flow over the SUPERCLAUS® stage in bypass to prevent diffusion. Carefully check during such operation for any deviation in temperature in the SUPERCLAUS® stage.

Conclusion

Unintentional accumulation of sulfur occurs frequently and in hindsight can almost always be explained.
As with other conditions that may arise in an SRU, accumulation in itself is only harmful when other conditions are met simultaneously.