

# Adsorbent unloading recommendations

**When unloading any Selexorb® or Activated Alumina bed which has been in hydrocarbon or hydrogen service, BASF advises the following:**

### Isolation of vessel

The material in the vessel needs to be regenerated first according to the indications/procedures as provided by BASF. Then the vessel needs to be depressurized. As a final step, the vessel needs to be separated safely from the rest of the unit by closing the respective isolation valves or putting in blinds.

### Inert gas purge of vessel

The vessel should be purged with nonflammable, inert gas. This does not apply if the regeneration has been done with nitrogen. This is done until the hydrocarbon or hydrogen content of the gas exiting the vessel is reduced below its lower level of flammability in air, as measured by a trained sampler using an appropriate calibrated combustible gas analyzer suitable for use with hydrogen gas and other hydrocarbons. The purge gas is routed to a safe location in accordance with all local regulations. This can be the off-gas system or a safe venting place. In certain cases, the purge gas could even be vented from the bottom dump via a blower or suction device.

### Choice of purge gas

Often, the most practical purge gas will be nitrogen. Typical commercially available

nitrogen qualities (containing at least 99.9 vol. % N<sub>2</sub> also referred to as 3.0) should be adequate. In any case, any oxygen content

present must fulfill the requirement that at no time the lower flammability or explosibility limit can be reached or surpassed. Ambient temperature nitrogen can be used for purging; however, the total quantity of purge gas required usually can be reduced by using hot nitrogen at a 125°C (257°F) vessel inlet temperature. Steam may be used as an alternative purge gas but nitrogen is generally preferred: It avoids the difficulties of dumping wet adsorbent, adsorbent clumping, slow dumping rate and sticking of adsorbent to the vessel walls. The use of steam may also be of concern if water reactive chemicals are present.

### Purge gas flow rate

It is important to use a flow rate of purge gas which is sufficient to avoid flow channeling. Flow channeling can cause pockets of insufficiently purged adsorbent as well as requiring an excessive volume of purge gas. To minimize the possibility of flow channeling, it is recommended to use a flow rate which results in the following minimum pressure drop: 0.0023 bar/meter of packed bed height (0.01 psi/foot). This can typically be achieved with flow rates of 100 Nm<sup>3</sup>/h per m<sup>3</sup> of adsorbent (100 scft /cft h).

Generally, it is most effective to use as low a purge gas pressure as is practical, in order to minimize the flow rate required to meet the minimum recommended pressure drop. The Ergun equation can be used to estimate the required flow rate using the above minimum pressure drop (linear velocity equivalent) criteria.

### Vessel unloading

The vessel can be unloaded through the dump port, lowest entry point to the bottom head or lower manway port. In any case, all of the adsorbent and bed support balls should be removed to allow inspection of the vessel and bed support grids and screens. Inspection and repair, as necessary, of the bed support grids and screens are important to provide trouble-free operation of the vessel after it is reloaded.

During the dumping, appropriate caution should be taken to avoid breathing any dust or residual vapors. Respiratory protection is recommended. When vessel entry is required, the vessel must be purged with air.

Before personnel are permitted to enter the vessel, the various energy sources (i.e., electrical, mechanical, pneumatic, chemical feed lines, etc.) must be isolated, tagged and/or locked in a zero-energy state position (chemical lines should be blinded in a flange or disconnected). Prior to entry, a reading for oxygen concentration and presence of combustible gas should be taken.

Entry must not be permitted if oxygen concentration is <19.5% or a combustible gas concentration is present.

If hydrogen sulfide is suspected, it would be appropriate to test for its presence as it is dangerous at even low levels of exposure and will require self-contained breathing apparatus.

Hot work like welding, cutting, grinding, burning or other spark or flame-producing operations are of concern and should only be permitted and approved by a trained individual upon determination that the vessel is safe for hot work. Smoking should be prohibited. The spent adsorbent itself may be irritating to the skin due to adsorbed chlorides, H<sub>2</sub>S and other contaminants adsorbed from the process stream. Appropriate skin protection should be worn and washing facilities should be available. The dumped adsorbent is not generally pyrophoric, if it has been properly purged, but adequate fire extinguishing equipment should be available in the immediate area as a precaution.

The spent material needs to be disposed off according to the local regulations in place. If the material is in the appropriate condition, it has even been reported that the material, can be used e.g. in construction.

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