WATCH® FERROLOX-G

OLD NAME FILTERSORB HSR®

General Information FERROLOX® - G

FERROLOX® - G is a iron hydroxide based, pelletized gas purification compound. It is particularly effective at removing Hydrogen Sulfide (H_2S) from gas-producing installations (i.e. digesters, landfills). It is optimally shaped and highly porous, thus ensuring maximum loading capacity at low costs.
The pelletized gas purification compound **FERROLOX® - G** is a highly effective absorption compound used in both, moving and fixed-bed vessels.

Technical Data

Chemical characteristics:	pelletized gas purification compound based on iron hydroxide combined with alkalizing compounds, binding substances and porosity inducing substances
Chemical formula:	$FeO(OH)$
Appearance:	light brown, variably-shaped granules
Standard pellet sizes:	For use in moving-bed columns: 5 - 25 mm, 8 - 25 mm, 10 - 25 mm For use preferred in fixed-bed columns: 2 - 4 mm, 2 - 8 mm, 4 - 8 mm

Loading Capacity:

Several parameters like the gas moisture, the H_2S concentrations in the crude gas stream, the ratio of the of the dosed oxygen resp. regeneration air, gas pressure levels in the installation, the dwell time in the column and the flow-rate of gas velocity, influences the reachable H2S loading capacity. The practical experience in operating columns indicates a loading capacity between 20 – 40 % weight of sulfur. Based on the solid **FERROLOX®-G**, loading capacities between **265** to **710 g** of hydrogen sulfide **per kg** of **FERROLOX®-G** are realized. With a typical moisture content of 12.5% of the **FERROLOX®-G**, loading capacities between **232** to **621 g** of hydrogen sulfide **per kg** of **FERROLOX®-G** can be reached.

Based on this results one can evaluate whether the gas purification compound has reached its maximum loading capacity and should be replaced or not.

Hydrogen Sulfide Removal

From:

- **Oil & Gas Industry**
- **Refineries including hydro-cracking**
- **Oil Storage Tanks**
- **Fuel Tanks**
- **Bio-gas production installation**
- **Landfills**

MEDICAL EMERGENCY

- **Hydrogen sulfide is classified as a chemical asphyxiant and similar to carbon monoxide and cyanide gases.**
- **Hydrogen sulfide inhibits cellular respiration and uptake of oxygen, causing biochemical suffocation**

EMERGENCY RESCUE

- Should a co-worker ever be overcome by H_2S gas, **do not attempt a rescue** until you are properly protected yourself.
- Remember at concentrations above 1000ppm, collapse, coma and death due to respiratory failure can occur within seconds after only a few breath.

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Effectiveness:

- ### Chemical reactions

The following chemical reactions shows the removal of H_2S from various gases through the use of the gas purification compound by **FERROLOX®-G.**

Absorption:

$2\ Fe(OH)_3 + 3\ H_2S \rightarrow Fe_2S_3 + 6\ H_2O$ - 62 kJ/mol (1)

Regeneration:

$Fe_2S_3 + 1½\ O_2 + 3\ H_2O \rightarrow 2\ Fe(OH)_3 + 3\ S$ - 603 kJ/mol (2)

The following summary is a presentation of the overall process:

$3\ H2S + 1.5\ O_2 \rightarrow\ {}^3/_8\ S8 + 3\ H_2O$, $\Delta G° = -665$ kJ/mol (3)

The reactions (1) and (2) are exothermic reactions whereby the regeneration reaction (2) creates 10 times more heat than the absorption reaction. This process can be particularly observed when the absorption and the regeneration process occur separately or the supply of oxygen or regeneration air is temporarily interrupted due to technical defects.

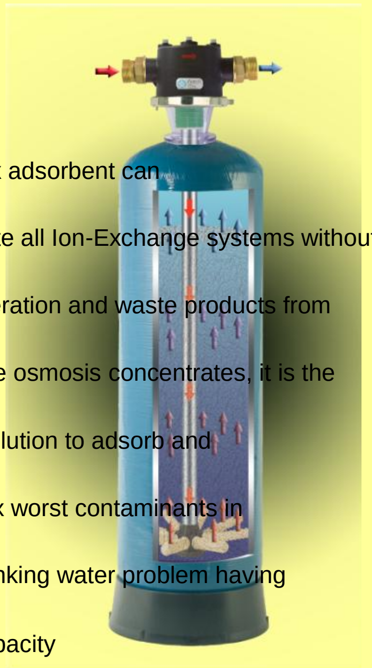
Caution: A partially regenerated mass of pellets containing sulfur, may ignite when comes in contact with oxygen. Sulfur ignites in air at temperatures ranging between 190 °C and 260 °C.

- ### Influence of gas moisture:

It was observed that during the reaction mechanism of the binding of hydrogen sulfide to the surface of iron hydroxide, the hydrogen sulfide first becomes soluble in water, which is contained in the mass as moisture. The hydrogen sulfide ions formed then reacts with the iron hydroxide to form iron sulfide. To enable this process and to prevent the pellets from drying out, a minimum moisture of the gas purification pellets needs to be ensured. Therefore, a relative gas moisture of minimum 40 % is required.

An increased gas or pellet moisture is also required for the regeneration due to the fact, that 1 mol iron sulfide consumes 3 mol of water to regenerate iron hydroxide.

When optimizing the moisture, it is recommended that the gas should not condense in the absorber or at least the condensate should remain in contact with the compound for extended period of time.



Ferrolox adsorbent can
Eliminate all Ion-Exchange systems without any
Regeneration and waste products from
Reverse osmosis concentrates, it is the
Only solution to adsorb and
Load six worst contaminants in
Our drinking water problem having
XXL capacity

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- **Sulfur precipitation:**

Following the regeneration reaction (2), elemental sulfur gets bound onto the surface layers as well as in the pores of the gas purification pellets. Thus the surface of the pellets, which contains the iron hydroxide, gets more and more blocked, which reduces the activities of the purification pellets. When a noticeable reduction in cleaning effectiveness is observed then the fully loaded mass of **FERROLOX®-G** should be replaced by fresh mass.

- **Siloxane binding (through adsorption) :**

With numerous studies, it has been proved that the gas purification compound **FERROLOX®-G** is capable of removing siloxane. This process occurs through adsorption though the chemical reaction as well as an achievable loading rate has not been investigated yet. Analysis of the gas purification compound used in municipal sewage treatment plants repeatedly shows evident loadings of decamethylcyclopentasiloxane and dodecamethylcyclopentasiloxane.
In order to reach a specific target or complete siloxane removal, we recommend a subsequent stage filled with activated carbon. The alleviation of the activated carbon due to a preceding removal of H_2S by using **FERROLOX®-G** is economically advantageous.

- **Preconditioning:**

When changing the gas purification compound in fixed-bed absorbers or when changing a large amount of **FERROLOX®-G** in moving bed absorbers, the arising heat and steam should be monitored.

The initial exposure of the gas purification compound to gas containing CO_2, transforms the calcium hydroxide into calcium carbonate creating heat and water (vapor) which can be seen in the following reaction:

$Ca(OH)_2 + CO_2 \rightarrow CaCO_3 + H_2O$ (4)

This reaction can cause the filter material and the exiting gas to reach temperatures between 70 - 80 °C within a short time.
This reaction, in which the pellets attain their final durability, is finished after a short time and the desulphurization unit is ready to be used.

The use of CO_2-poor and humid gas during the preconditioning stage depends on local conditions and the method used should be determined accordingly.

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- **Conditions for the application:**

The gas purification pellets **FERROLOX®-G** can be applied in both, fixed-bed absorbers and tower-shaped absorbers which are often operated on the principle of moving beds. In fixed-bed absorbers, the mass gets replaced once the effectiveness of the gas purification diminishes, are filled prior to the desulphurization, tower desulfurizers operate through the continuous rotation of the gas purification compound. The loaded material is removed through the discharge valve beneath the gas purifier, while fresh material is added through the loading valve located at the top of the desulfurizer.

The gas passes from the bottom to the top and thereby moves against the direction in which the gas purification compound is moved. Should the gas purification compound which may not be fully loaded yet (which is often the case with gas containing low levels of hydrogen sulfide), it can once again be filled into the top of the reactor.

The material should be sieved before to remove all fines and dust caused by the downward movement of the pellets. Almost fully-loaded purification pellets can be identified by their black-grey color that will not change, even when exposed to oxygen. In order to avoid any blockage or mineralization of the purification compound, the pellets should be moved by taking some material out at regular intervals of about 14 days. Due to the different types of desulfurization installations and the wide variation of desulfurization equipment available, we are only able to provide the following general information:

Hydrogen sulfide concentration in raw gas:	ca. 50 ppm - ca. 15.000 ppm
Fill height of gas purification compound:	min. 0.5 m (1.64 feet); max. ca. 12 m (39.4 feet)
Pressure loss in the filter-bed:	< 1 to 15 mbar (0.014 to 0.22 psi), depending on the filling height, the chosen size of pellets as well as the velocity / flow rate of the gas
Pressure range:	no pressure – ca. 25 bar overpressure
Contact time of the gas rel. to the empty vessel:	ca. 20 sec – ca. 3 min
Flow rate of the gas in the filter:	ca. 2 m/min (6.5 feet/min) – ca. 15 m/min (49 feet/min)
Relative gas moisture:	at least 40 %, optimally 60 % - 80 % relative moisture - non condensing
Moisture content in pellets:	min. 5 %, optimally 10 % - 15 %
Necessary amount of oxygen for regeneration:	about 2 - 4 x stoichiometric excess relative to the concentration of H_2S in raw gas

Thus for the regeneration reaction at a gas stream where 1000 ppm H_2S needs to be removed, regeneration air should be added at the rate of approximately 1 - 2 % by volume. Instead of air, 0.2 - 0.4 % pure oxygen can be used as well.

In order to assure the complete utilization of the gas purification pellets in fixed-bed desulfurizers, we recommend a multi-stage arrangement of individual tier absorbers in which the compound of each individual tier can be replaced separately and where the sequential arrangement of the absorbers can be changed.

Any condensation within the reactor should be removed regularly. Direct contact with water needs to be avoided, as the pellets can dissolve and/or turn into iron hydroxide sludge.

Be cautious when filling the gas purification pellets into the vessel. Rough handling may cause the pellets to fall apart, thereby decreasing the effectiveness of the product. We recommend attaching an extension hose to the spout of the Big-Bag when filling the desulfurizer for the first time, so that the pellets can be placed at the bottom of the tower gently.