Shaffer
A Varco Company

PRODUCT INFORMATION BULLETIN

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Title

EFFECTS OF H_2S/CO_2 ON BLOWOUT PREVENTER COMPONENTS

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Written By

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Shaffer ram preventers have been successfully used in many different field conditions throughout the world. The design of the preventers meets API specification. Base operating limits are used for those design qualifications.

BOPs may be required to function outside of these base conditions. For example, H_2S and CO_2 are oilfield compounds that are detrimental to the materials, both metallic and elastomer, used in blowout preventers. Shaffer blowout preventers are qualified to base conditions of 25% of H_2S and 15% CO_2.

This P-I-B will summarize the effects of using Shaffer blowout preventers in applications where the H_2S and CO_2 concentrations exceed the base conditions and the steps that need to be followed by operators under such conditions.

METALLIC COMPONENTS

The metallic components of a blowout preventer are detrimentally affected by both the H_2S and CO_2 exposure. To limit the detrimental effects of the H_2S exposure, material selection is critical to the safe use of the blowout preventer. Material selection guidelines are provided within the NACE (National Association of Corrosion Engineers) international standard, MR0175, Standard Material Requirements, Metals for Sulfide Stress Cracking and Stress Corrosion Cracking Resistance in Sour Oilfield Environments.

Materials selections for the H_2S exposure are not, however, as suitable for the CO_2 environment. The CO_2 environment will cause severe corrosion and weight loss on the materials normally selected for blowout preventer components. If CO_2 levels are higher than the base design, additional considerations need to be taken to insure the metallic components are not compromised. This may require more sophisticated material selections; however, this may be cost prohibitive as the materials required are more expensive to process for the manufacture of blowout preventers. The usual method of providing the protection required for the metal components of a blowout preventer is to use corrosion inhibitors within the drilling fluids.

ELASTOMER COMPONENTS

The selection of elastomers for use in the H_2S and CO_2 environment is critical for the proper functioning of the components. Due to the design of the blowout and function requirements of preventer parts, the selection of H_2S and CO_2 resistant elastomers is limited. The most common elastomer selection has been the nitrile compounds such as NBR (butadiene-acrylonitrile) and HNBR (hydrogenated butadiene-acrylonitrile). The mechanical properties of these nitrile elastomers used in blowout preventers degrade when exposed to increased levels of H_2S and CO_2. Shaffer blowout preventers have been deployed in applications with higher levels of concentration without experiencing a single failure. The service life of the elastomer components is expected to decline with the increased exposure to H_2S and CO_2, necessitating the need for strict management of elastomer condition. Increased test frequency and elastomer replacement are critical to successful application in these increased exposure wells. The physical properties of the elastomer compound are affected by the exposure to the H_2S environment. The main concern for the elastomer from the CO_2

exposure is the gas migration into the part while under pressure. When the pressure is released, the gas does not efficiently escape the part and blistering occurs. This phenomenon is known as explosive decompression.

Figures 1 and 2 illustrate the typical amount of degradation as measured by Ultimate Tensile Strength and Rubber Elongation respectively after 70 hours exposure at 250° F (122° C).

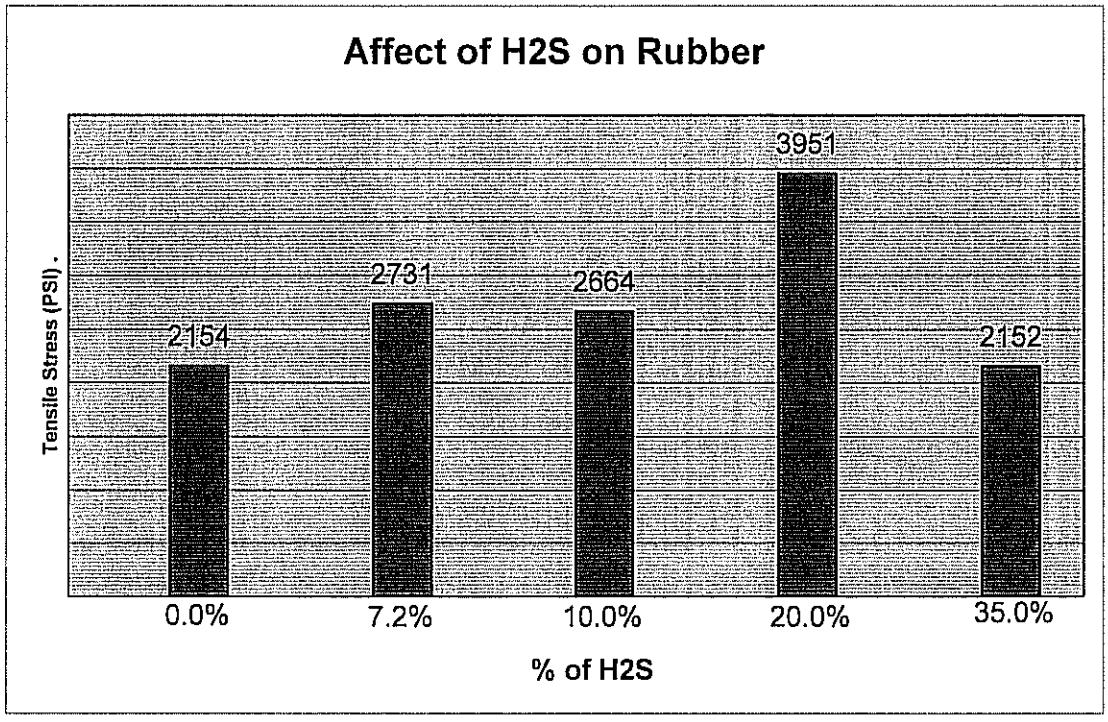

Figure 1: Change in Ultimate Tensile Strength as a function of % H_2S. All tests were performed with 15% CO_2.

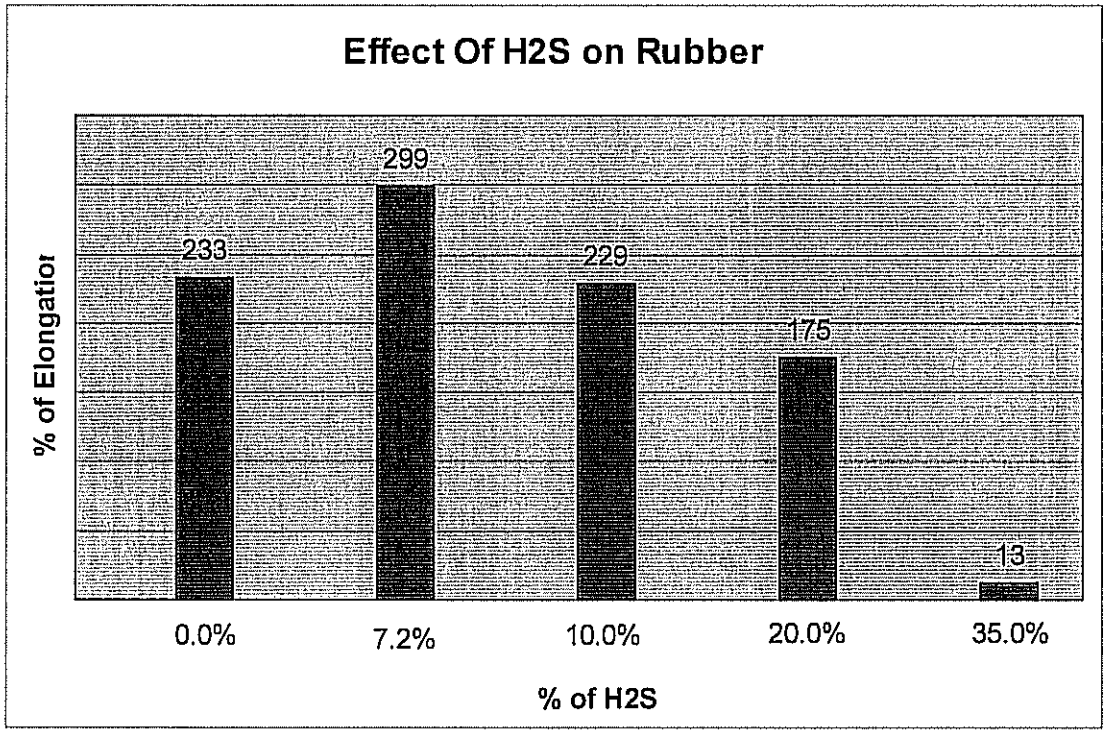

Figure 2: Change in Elongation as a function of H_2S. All tests were performed with 15% CO_2.

The tests reflected in the charts above indicate increased tensile with exposure to increasing levels of H_2S. Tensile strength is a measurement of the energy required to break the rubber test coupon. The tests also indicate elongation is reduced at high H_2S levels. Elongation is a measurement of the amount the rubber test coupon will stretch before it breaks. The increased tensile strength and reduced elongation properties will make the elastomer less compliant and more likely to be damaged in service.

Recommendations:

Shaffer rams and Ultratemp® rams may be deployed in applications where H_2S and CO_2 concentrations exceed the base conditions. However, Shaffer recommends the following steps be taken:

1. Additional inspections and seal replacement are required as a result of the elevated H_2S and CO_2 levels; and

2. Operation in extreme applications, such as 35% H_2S and 15% CO_2, requires that the operator develop and implement a dedicated inspection and maintenance schedule based upon well conditions and the effects on the elastomer performance.