



REVIEW ARTICLE

Monitoring of trace chloride ions at different stages of the gas production process



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Abstract Fifty gas and liquid samples at different stages of Obaiyed gas plant in Egypt were selected and subjected for determining chloride ion and hydrocarbon compositions. The trace levels of chloride in the water extracted from natural gas, condensate, Benfield and glycol samples were achieved using ion chromatograph (IC), electrical, conductivity and potentiometric methods, respectively. The hydrocarbon compositions were analyzed and evaluated using capillary gas chromatography. The chloride ions in natural gas and condensate are a function of water content and their concentration mainly depends on the separation efficiency. Variability in natural gas and condensate compositions seasonally is not an uncommon occurrence. Our aim is monitoring of chloride ion to select and optimize the conditions of sweetening and dehydration regenerators in order to follow and prevent their gradient in gas plant.

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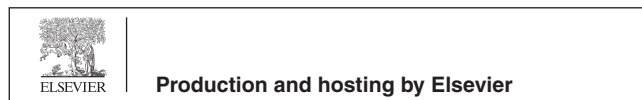
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1. Introduction

As one of the cleanest, safest, and most useful of all energy sources, natural gas is a vital component of the world's supply of energy (Speight, 2007). Natural gas is a combustible mixture of hydrocarbon gases and small quantities of various non-hydrocarbons existing in the gaseous phase or solution with oil in natural underground reservoirs at reservoir conditions (Widia, 2003; EIA, 2005; Fox et al., 1996; Carcoana, 1992).

From whatever reservoir, the composition of natural gas as produced from the earth depends on the field, the formation, or the reservoir from which it is produced (GPA, 1998). The principal constituent of natural gas is methane (Fox et al., 1996). Other constituents are paraffinic hydrocarbons such as ethane, propane, butanes and a small proportion of pentane + (C₅+) hydrocarbons (Mokhatab et al., 2006). Some aromatics such as benzene, toluene, and xylenes can also be present, raising safety issues due to their toxicity. Natural gas may also contain other contaminants such as hydrogen sulfide, carbon dioxide, mercaptans, and water vapor.

Water vapor is the most common undesirable impurity in gas streams (Nivargi et al., 2006). All natural gases contain water vapor to some extent (Manning and Thompson, 1991), which comes from the water phase in the reservoir. Concentration of such water vapor range from trace amounts to saturation (Kidnay and Parrish, 2006). This water vapor is the main source of the chloride ion in natural gas and its concentration depends on the concentration of the chloride ions in the reservoir water phase. The vapor cause operational problems such as hydrate formation, corrosion, high pressure drop, and consequently slugging flow and reduction in gas transmission efficiency (Karimi and Abdi, 2006). In particular, moisture level in natural gas must be maintained below a certain threshold so as to prevent hydrate formation and minimize corrosion in transmission pipelines (Campbell, 1992; Manning and Thompson, 1991; Pearce and Sivals, 1984; Grizzle, 1993).

The Obaiyed field is a gas-condensate reservoir located in the Western Desert of Egypt (Obaiyed Training Manual).

The reservoir contains up to 8 mol% CO₂, requiring special metallurgy to avoid corrosion and acid gas removal to meet sales gas specifications. Obaiyed production facilities are designed to produce a daily contract quantity (DCQ) of 360–425 MMscfd of sales gas at an export pressure of 101 bars. The facilities consist of two gas processing trains, each train having a capacity of 210 MMscfd, and therefore the utility systems are designed for a throughput of 420 MMscfd sales gas.

The processing of natural gas consists of the separation of some of the components present at the well exit, such as water, acid gases and heavy hydrocarbons, to adjust the gas to transport or commercial specifications (Rojey et al., 1997). The distribution of these operations between the field and the delivery point is dictated by economic considerations. It is usually preferable to conduct on the production site only operations that make the gas transportable. In simple terms, the gas processing industry gathers, conditions and refines raw natural gas from the earth into saleable, useful energy forms for use in a wide variety of applications (GPA, 1998).

Our study based on monitoring the chloride ion concentration in natural gas in the outlet gas separators streams and during sweetening and dehydration of natural gas. This study was performed by collecting the samples through three trips in one year. Obaiyed gas plant uses (Benfield solution) for acid gas removal process. The Benfield solution is a 30 wt% potassium carbonate solution, with 1 wt% (ACT), (UOP) a proprietary activator with speed up the reaction, and 1 wt% of vanadium pentoxide as corrosion inhibitor that passivates carbon steel. Glycol was used as a dehydrator absorbent for natural gas stream.

2. Experimental

2.1. Hydrocarbon compositional analysis

2.1.1. For gases

Hydrocarbons from C₁ to C₉, carbon dioxide, and nitrogen were analyzed using Agilent model 6890 plus HP gas chro-

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