

Laboratory Evaluation Of Corrosion Inhibitor And The Performance Requirements In Gas Gathering And Transportation Pipelines

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ABSTRACT

The performance requirements, corresponding indexes and laboratory evaluation methods of corrosion inhibitors have a direct impact on the selection of corrosion inhibitors. The performance requirements of corrosion inhibitor for natural gas gathering and transportation pipelines can be summarized into two aspects: corrosion inhibition and usability performance. Corrosion inhibition includes inhibition performance in aqueous phase and in TOL. Usability include compatibility, stability, pouring point, emulsifying tendency, etc. Based on the some different types of gas fields requirements, the performance requirements and corresponding indexes of corrosion inhibitors for wet gas gathering and transportation pipeline are analyzed, and the corresponding performance indicators of corrosion inhibitors for different types of gas fields are proposed. Finally, the commonly applied laboratory evaluation methods in current active standards have been analyzed and summarized, and verified.

Key words: corrosion inhibitor, usability performance, environmental performance

INTRODUCTION

At present, with the increasing in demand for natural gas, all gas production companies are increasing their efforts in natural gas exploration and development. Corrosion is one of the problems during the wet gas transporting, and this can be solved by adding corrosion inhibitor (CI) in most case. However, there are no standards for the CIs performance used in gas gathering and transportation pipelines, which may lead to some gaps between the R & D scientists and the needs of corrosion inhibitor users. Based on the demand of some gas production companies for the CIs, this paper puts forward the performance requirements and corresponding indexes of CIs for natural gas gathering and transportation system, and given some advice on the evaluation method.

The Performance Requirements of CI used In Gas Gathering And Transportation Pipelines

Tender Information Requirements Examples of Some Gas Fields

Gas production companies, as the natural gas producers, are the direct users of corrosion inhibitors during natural gas development and production, and thus can get the first-hand data after the application of corrosion inhibitors. Therefore, collection of the requirements for corrosion inhibitor properties from the gas production companies is of great guiding significance for specifying the targeted performance requirements of corrosion inhibitors.

The tender information on corrosion inhibitor performance of the four gas fields is as follows (Table 1)..

Table 1 Examples of corrosion inhibitor performance requirements in some gas fields

Properties	Indicators			
	gas fields 1	gas fields 2	gas fields 3	gas fields 4
Inhibition performance (aqueous phase)	$\leq 0.076 \text{ mm/a}$	$\leq 0.076 \text{ mm/a}$	$\leq 0.1 \text{ mm/a}$	$\leq 0.102 \text{ mm/a}$
Inhibition performance (TOL)	-	-	$\leq 0.1 \text{ mm/a}$	$\leq 0.102 \text{ mm/a}$
Appearance	Homogeneous liquid	Homogeneous liquid	Homogeneous liquid	-
Pour point	$\leq 0^\circ \text{C}$	$\leq -15^\circ \text{C}$	$\leq 0^\circ \text{C}$	-
Flash point	$\geq 45^\circ \text{C}$	$\geq 45^\circ \text{C}$	$\geq 45^\circ \text{C}$	-
Compatibility	Compatible with field water	Compatible with field water	Compatible with field water	No mutual adverse effect with MEG and elastomer
Foaming tendency	The volume of foam formed < 10% of agitated liquid and < 3% within 180 seconds	The volume of foam formed < 10% of agitated liquid and < 3% within 180 seconds of being left to settle	-	The volume of foam formed < 30% of agitated liquid and should dissipate within 120 seconds of being left to settle
Thermal stability	No precipitation and no obvious change in physical and	No precipitation and no obvious change in physical and	No precipitation and no obvious change in physical and	No precipitation and no obvious change in physical and

	chemical properties	chemical properties	chemical properties	chemical properties
Emulsion tendency	-	All phases should be clearly visible. If emulsion is formed, it should dissipate within 600 seconds	-	All phases should be clearly visible. If emulsion is formed, it should dissipate within 120 seconds
Viscosity	-	-	-	< 50 mPas at 15°C
Vapor pressure	-	-	-	Vapor pressure < 12psi at 45°C

Gas fields 1 is a sour gas field with H₂S levels of 1%~2% and CO₂ levels of 3~4% in southwest China.
 Gas fields 2 is a sour condensate gas field with H₂S levels of 3%~4%, CO₂ levels of 5~6%, condensate levels of 2~7g in each cubic meter of natural gas in Central Asian.
 Gas fields 3 is a sweet offshore gas field with CO₂ levels of 16~25% in China.
 Gas fields 4 is a sour gas offshore condensate gas field with H₂S levels of 0.5%~1% and CO₂ levels of 2~3% in Middle East.
 We can see that the performance requirements of corrosion inhibitor for natural gas gathering and transportation pipelines can be summarized into two aspects: corrosion inhibition performance and usability performance.

Performance Recommendations for CIs

It can be seen from the practical performance requirements for corrosion inhibitors by the gas production management that there is a slight difference in performance requirements for corrosion inhibitors in different types of gas fields. For none condensate gas field, emulsion tendency is not important. For sour gas field, foaming tendency should be considered. For offshore gas field, TOL inhibition ability is preferred.

Corrosion Inhibition Performance

The main purpose of adding corrosion inhibitors in the gas production is to mitigate the corrosion. Therefore, corrosion inhibition performance is the most basic technical requirement for corrosion inhibitors. Since TOL corrosion is mostly occurs in offshore gas fields, the corrosion inhibition performance of TOL could only offshore gas fields.
 In the design of thickness of gathering and transportation system, a corrosion allowance will be preset, usually about 3mm. The life of a natural gas field is generally 20 - 30 years and the acceptable converted corrosion rate is thus 0.1 mm/a. For the reasons, the indicator for corrosion rate is set to be 0.1 mm/a.

Appearance

Appearance is a visualized factor for evaluating the product quality and identifying whether the product can be used in the gasfield. Therefore, appearance shall be listed as one technical requirement. A qualified corrosion inhibitor shall be homogeneous liquid, which means a uniform system with all compositions of the same nature.

Pour Point