Northeast GAS ASSOCIATION

NYSEARCH

Technology Brief

Gas Interchangeability Study for LDC Infrastructure Integrity

Description: **A comprehensive, materials and components study of the effects of varying gas compositions on the performance of natural gas distribution system infrastructure components**

Status: **Progressing through laboratory testing of field extracted couplings and elastomeric materials**

BENEFITS

The objective of this program is to study the effects of varying natural gas compositions on various components of the gas distribution infrastructure. Prior experience with changes in gas supplies indicates that some components of the infrastructure might be affected by the introduction and/or absence of several constituents in the gas supply, thus necessitating potentially costly response measures.

Understanding of these effects will allow Local Distribution Companies (LDCs) and other stakeholders involved to better plan for the introduction and/or management of diverse gas supplies in the country's distribution system.

BACKGROUND

As gas supply in the United States gets increasingly diversified, its composition is experiencing an increasingly greater variation. Both distribution system components and end-use equipment have been designed and operated over the last decades based on a more stable and well defined gas composition. The Natural Gas Council Plus (NGC+), a working group representing all stakeholders, has prepared a white paper on Gas Interchangeability, which outlines a broad and rather comprehensive strategy for dealing with the issue. NYSEARCH has addressed a specific, but most critical issue from among those discussed in NGC+'s white paper, that is the effect of varying gas composition on the operating components of the gas distribution network.

TECHNICAL APPROACH

NYSEARCH retained the Gas Technology Institute (GTI) to carry out a systematic study of varying gas composition effects on various infrastructure components. The program has been structured as a multi-phase effort designed to understand the underlying scientific and engineering basis of these effects.

Phase I of this effort was initiated in late 2005 by carrying out a series of tasks aimed at defining the program. These tasks included: (a) collecting via a survey the gas composition, and infrastructure materials and components that the members would like to test as part of this program, (b) conducting a review of literature on background work, and (c) developing a testing protocol to determine the response of the elastomeric materials found in these components to changing gas compositions (for the gases identified through the survey). Six classes of elastomeric materials were identified as integral to all the infrastructure components to be considered. Two sets of detailed testing protocols were then developed in order to test these materials. The first set is being used to benchmark the materials, i.e. identify their chemical composition and determine their mechanical, thermal and other properties. Once benchmarking tests are completed for all vintages, those that are indeed substantially different from earlier or later vintages are being tested using the second set of testing protocols. These tests allow us to determine the change in the mechanical and thermal properties of these materials when exposed to varying gas

compositions, thus allowing us to determine the class of materials that would potentially result in changes in the performance characteristics of the infrastructure components they are found in.

Following the completion of this early work in late 2006, which established the framework of the entire program, a second phase was initiated. In this second phase, a number of compression couplings, very common in the distribution networks of LDCs, are being tested under various pressure, temperature, and gas composition conditions in order to provide the industry with a first indication of the behavior of these components under these varying operating conditions. This allows participating companies to plan their operations and maintenance programs for the upcoming years and to initiate discussions with other stakeholders on planning strategies related to the introduction of alternate fuel sources in LDC distribution networks. All couplings under test were extracted from the piping network of member utilities.

In order to carry out this phase of the program, extraction protocols were developed detailing the process through which the couplings were to be extracted from the piping network. This issue is of the utmost importance, since any coupling tested need not be disturbed during the extraction process.

Figure 1: Testing Setup with Environmental Chamber in the Background

In order to establish the conditioning times of these couplings, i.e. the time required for the elastomer in the coupling's seal to reach an equilibrium state in terms of the gases diffused into the seal, a series of tests were initiated in 2007, and completed in 2011, using new couplings. These tests determined the excessive length of time needed for a coupling to remain under a certain pressure, temperature and gas composition prior to the elastomer reaching equilibrium state under those conditions. With this knowledge established, the leak tests were finally initiated, as shown in Figure 1. In these leak tests, the extracted couplings are placed in an environmental chamber and undergoing a systematic exposure to a series of temperature, pressure and gas composition variations, representative of those they encounter in the field. The couplings are monitored for leakage through pressure and methane detection sensors.

In the meantime, a third phase or segment of the program was initiated that involves the systematic testing of all elastomeric materials encountered in the field, as per the testing protocols developed in Phase I. Material composition identification studies were carried out to fully characterize the elastomers, while comparative studies establish their response to exposure of varying gas compositions under variable conditions (in these studies the elastomeric materials are tested separately; not as part of the coupling or other infrastructure component within which they normally operate).

PROGRAM STATUS

The second and third phases of the project are currently underway. The tests to determine the conditioning times of compression couplings have been completed and the leak tests for the extracted couplings have been initiated. It is expected that leak tests will be concluded in late 2013.

Highlights

- Phase 1 determined classes of materials and what to test.
- Second phase is a lengthy program to determine equilibrium conditioning times and to test full couplings for leakage
- Individual elastomeric materials are being tested in a parallel phase.

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