Northeast GAS ASSOCIATION
NYSEARCH

Technology Brief

Methane Oxidation Catalysts for Reduction of Emissions in Flaring

Description: **To develop a catalyst material that can oxidize methane and hydrocarbons at low temperatures and employ these materials in devices to provide a viable alternative to flaring of natural gas.**

Status: **In partnership with a methane combustion technology company and a catalyst manufacturing expert, NYSEARCH is working to develop the first catalytic oxidizer device to be tested in controlled field conditions.**

BENEFITS

Flaring of natural gas is a common practice in industry when necessary to de-pressurize systems and complete blowdowns for maintenance and operations. The result of flaring is the burning or combustion of methane and other natural gas components. Methane emissions reduction has been a key goal for utilities and reducing GHG emissions overall throughout the entire distribution system. Although flaring oxidizes methane, other resultant pollutants are generated from the combustion of methane particularly SO_x and NO_x.

A new catalyst technology to increase the rate of the combustion process, while lowering combustion temperature would eliminate the release of these pollutants. Catalytic oxidation is also flameless, eliminating the perceived fire risk of flaring operations. The catalytic material could potentially be scaled into a field-deployable product that processes methane at lower temperatures without production of pollutants and a flame.

Figure 1. Methane oxidation reaction: methane mixed with oxygen combusts yielding carbon dioxide and water

BACKGROUND

Current natural gas transmission and distribution operations activities to reduce methane emissions include flaring, drawdown compressors or pump-down techniques, isolation of short sections, and other stoppel techniques. In many situations and depending on state regulations, the economics of drawdown compression limit those activities and then flaring of natural gas is still required. Flaring brings its own issues particularly the release of pollutants that come from the combustion of methane, NO_x and SO_x. The natural gas industry is exploring new technologies to minimize or eliminate flaring and other contributors to the release of emissions.

In catalytic methane combustion, natural gas is reacted with oxygen or air mixtures over a solid catalyst at lower temperatures than those at which NOx and other pollutants are formed without the production of a flame. This catalytic approach was confirmed as successful by Stanford's research, and we are now working in partnership with a commercial methane combustion technology company, Questor Technologies, Inc., to scale the catalyst oxidizer into a field-deployable process. With the industry expertise and experience of methane combustion from Questor, we are determining if a typical volume of gas could be processed through this new form of methane oxidation without pollutants.

TECHNICAL APPROACH

The research work focuses on prior work completed by Stanford and with catalysts like the pure metal element, Palladium (Pd). Current state-of-the-art catalysis of methane oxidation occurs with Pd/Al_2O_3, which is palladium particles distributed on an aluminum oxide support. Given a range of volumes of methane to be processed, the amount of Pd catalyst and processing time needs to be optimized. Palladium, like other metals, is expensive and needs to be minimized. Optimization requires investigating the rate of catalyst reaction at various temperatures, exploring different types of supports to distribute Pd particles, and evaluating doping effects on the Pd particles with different types of metals. Evaluating each of these parameters will help determine the most optimal catalyst combination to process volumes of methane at low temperatures using minimal amounts of Pd. Laboratory testing is conducted at molecular levels in the nanoscale range. Palladium catalyst modifications and various parameters are synthesized in the lab for testing.

The ultimate goal is to find the best Pd catalyst conditions to: 1) improve the catalytic rate of the current state-of-the-art Pd/Al_2O_3, 2) achieve a process where oxidation of the natural gas would be performed with reasonable amounts of Palladium, and, 3) achieve methane oxidation in a matter of hours.

An optimal Pd catalyst formulation has been achieved and now a path to manufacturing and scaling the champion Pd catalyst is defined. The scalability of manufacturing the catalyst will determine the design of the catalytic oxidizer device and the processes and equipment needed to address various environmental conditions. Questor Technologies deploys a line of thermal oxidizers that share similar operational conditions to the potential catalytic oxidizer device. Figure 2 is an example of a commercial thermal oxidizer available today for methane oxidation.

PROGRAM STATUS

NYSEARCH testing of various parameters for optimizing the current-state-of-the-art Pd catalysis reaction has identified a champion Pd catalyst system to be used in development of a thermal catalytic oxidizer prototype. Further catalytic testing and a scalable manufacturing pathway is being investigated. Once a manufacturing pathway is set and the catalyst testing is complete, the design prototype can be finalized and built for field demonstration. The oxidizer would be taken to a site with a controlled natural gas release and gas quality and temperature analysis of the product stream would confirm feasibility of the catalyst's potential for full methane oxidation.

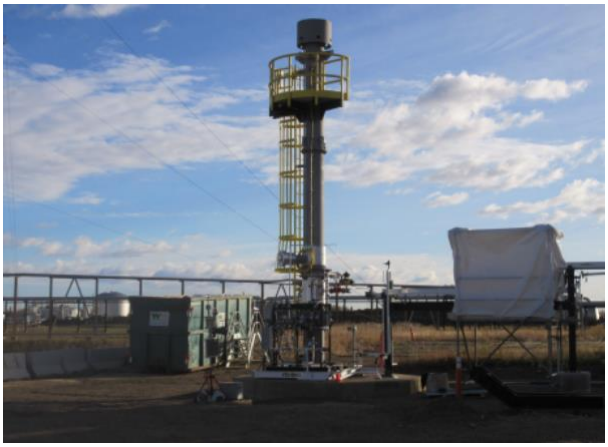

Figure 2. Questor Technologies Q-series thermal oxidizer at a customer site

Highlights

- Catalytic oxidation offers a methane emissions reduction solution that is flameless and since combustion takes place at lower temperatures, the release of SOx and NOx is also eliminated.
- NYSEARCH is working with a methane combustion technologies company and a catalyst manufacturing expert to develop the first catalytic oxidizer device to replace flaring.

For more information contact:
admin@NYSEARCH.org