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ENVIRONMENTAL CONSIDERATIONS FOR GASKET SELECTION AND THE DEVELOPMENT OF AN EMISSIONS CALCULATOR FOR GASKET MATERIALS

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ABSTRACT

The choice of gasket type for flanged connections has typically been determined on the basis of temperature, pressure, and chemical nature of the contained fluid; sealability; ease of handling and installation; expected service life; comparable cost; and other factors. Of ever increasing importance is the environmental performance of the selected gasket with an emphasis on fugitive emissions reduction. All gaskets have some level of fluid leakage but this may vary significantly depending on the type selected. A practical tool using Microsoft® Excel® has been developed that can help predict anticipated fugitive emissions of gaskets for which Room Temperature Testing (ROTT) data are available. The construction and application of this tool are described and a relative comparison of tightness parameters and projected fugitive emissions for example gasket types are documented.

INTRODUCTION

The Clean Air Act (CAA) is the comprehensive federal law that regulates air emissions from stationary and mobile sources. Through this law, EPA is authorized to establish National Ambient Air Quality Standards (NAAQS) to protect public health and public welfare and to regulate emissions of hazardous air pollutants (HAPs). In 1977 and 1990, the CAA was amended to set new dates for achieving attainment of NAAQS as many areas of the country did not meet the original deadlines. "Major sources" are defined as a stationary source or a group of sources that emit or have the potential to emit 10 tons per year or more of a single HAP or 25 tons per year or more of a combination of HAPs. Fugitive emissions make up a significant percentage of all air emissions. USEPA's Toxic Release Inventory (TRI) shows that fugitive HAP emissions entailed 22% of the total air emissions of all HAPs chemicals reported by U.S. industry in 2012. [1] USEPA has determined that at a typical chemical plant, the highest percentage of mass leak rates (62%) occurs through valves. The second highest (31%) is leakage through connectors. [2]

The requirements for fugitive volatile organic compound (VOC) emissions control of equipment leaks are found in various EPA regulations. A majority of them are included in the New Source Performance Standards (NSPS), the National Emission Standards for Hazardous Air Pollutants (NESHAPs), and the Hazardous Organic NESHAP (HON). Under these regulations, various industries are affected and must control their fugitive VOC emissions.

This paper addresses the application of gasket test data and a series of empirical equations as developed by the Pressure Vessel Research Council as a method to determine the relative leakage rates of VOCs from bolted flanged joints which comprise an important percentage of all connectors at a plant.

NOMENCLATURE

a	slope of loading curve in a ROTT test
A_c	contact area of gasket, square inches
A_i	internal pressurized area of gasket, square inches
BFJ	bolted flanged joint
d	outer diameter of gasket, inches
G_b	Y-intercept of the loading curve in a ROTT test, psi
G_s	Y-intercept of the unloading curves in a ROTT test, psi
k_f	slope of unloading curve in a ROTT test (see Eq. 3)
L_r	unit leak rate, mg/sec/mm gasket diameter (see Eq. 5)
L_{tot}	gasket total leak rate, kg/hr (see Eq. 6)
NPS	nominal pipe size