WHITE PAPER

Better Air Quality for a Cleaner Environment

The Force is with Us… But We Need to Control It to Survive

Introduction

There is an undeniable force amongst us. Unlike the metaphysical power made famous by the movie *Star Wars*, this force is real, manmade, and has the ability to alter and even threaten the global environment. What is this irresistible power? In a word, it is humankind.

The Rise of Greenhouse Gases

Human civilization has played a leading role in creating massive amounts of greenhouse gas to affect the environment through the millennia.[1] For many scientists, the delicate balance between man and nature over the previous epochs took a dramatic turn in 1784. That was the year James Watts invented the steam engine. It also marked the beginning of the Industrial Revolution that gave rise to urbanization and an era of unprecedented change. Human endeavors now took on a decidedly mechanical bent that filled the air we breathe with increasing amounts of something that continues to plague us on a global scale – pollution.[2]

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While our part in altering Earth's environment remains a hotly debated issue, one thing is certain. The global temperature is rising.[3] The good news is our interference with the natural order of things in the atmosphere is likely pushing off the next ice age by at least 100,000 years.[4] The bad news is this: "Human activities have contributed substantially to climate change by adding carbon dioxide (CO2) and other heat-trapping gases to the atmosphere," the U.S. Environmental Protection Agency (EPA) says. That means the Earth's atmosphere is becoming warmer, and that primarily "human activity is affecting the amount and rate of climate change mainly due to greenhouse gas emissions from the burning of fossil fuels," the EPA reports.[5]

To acknowledge our role in reshaping the environment, a growing number of prominent scientists are now advocating that human influence on the atmosphere marks a distinctly new epoch in history, which they call the Anthropocene Age. First coined in the 1980s by Paul Crutzen, a Dutch chemist who won the Nobel Prize for his work on ozone-depleting compounds, the term Anthropocene Age references the impact of human behavior on the global environment.[6] According to Crutzen, the unbridled creation of greenhouse gases (GHGs), including volatile organic compounds (VOCs), should serve as a warning that could well jeopardize the integrity of Earth itself.[7]

Understanding Greenhouse Gases and Volatile Organic Compounds

Buried far below such alarming headlines is the need for a concise explanation and understanding of GHGs and volatile organic compounds (VOCs). Here is a start: Carbon dioxide (CO_2) accounts for 82% of GHGs, which enters into the atmosphere through burning fossil fuels, such as gasoline, diesel, coal, natural gas, oil, solid waste, and wood. Number two on the GHG list is methane (CH4), a byproduct of coal, natural gas, and oil production. It composes about 10% of GHGs, and is a major contributor to lower atmosphere ozone. Methane emissions also result from the normal digestive process of livestock and the decay of organic waste. Next is nitrous oxide (N_2O), also generated from fossil fuel combustion. It accounts for 5% of GHGs. The remaining 3% of GHGs contains various fluorinated gases resulting from a range of industrial procedures.[8]

VOCs, on the other hand, are organic compounds that quickly vaporize into the environment near ground level. An estimated 80% of VOCs enter into the atmosphere through emissions from gas-fueled vehicles. One of the most toxic of these is benzene (C_6H_6), a chemical used extensively in U.S. industry for a variety of purposes, from a component in gasoline, plastics, resins, wax, and paints to detergent, pesticides, and even explosives. Found in nature, benzene is also a natural part of crude oil and cigarette smoke. Useful as it is, the EPA classifies benzene as a known human carcinogen for all routes of exposure.

Fenceline Monitoring of Benzene

Moving forward in protecting our environment, in 2011, the EPA completed its first-ever comprehensive data collection of hazardous air pollutants (HAP) from U.S. petroleum refineries. EPA modeling estimates that some 5 million people live within a 30-mile radius of a refinery.[9] The EPA believed that a significant but uncertain amount of those HAPs actually originated from "fugitive" sources. Those sources included equipment leaks and pressure relief devices, tanks and transfer operations, and wastewater handling and treatment processes.[10]

When combined with data from earlier EPA pilot studies of fenceline monitoring models, the 2011 refinery HAP data suggested that the largest concentrations of fugitive emissions likely occur by the property boundary lines near the ground level. Since benzene is a refinery risk driver thought to originate from those same fugitive release sources, the EPA believes that "reducing emissions of benzene from fugitive sources will reduce emissions of other pollutants."[11] According to the EPA's Jason DeWees, "perimeter or fenceline monitoring provides an indicator of the level of emissions at refineries and is a way of ground-truthing fugitive emission estimates."[12]

Moving Towards a New Standard

In 2012, several environmental and public health groups filed a lawsuit against the EPA alleging that the agency missed statutory deadlines to review and revise Refinery Maximum Achievable Control Technology, known as MACT 1 and MACT 2. The Clean Air Act requires the EPA to review these emissions standards every eight years. The last time the agency did so, however, was 2002. To settle the suit, the EPA issued new refinery regulations to track fugitive releases of benzene and associated compounds. Known as Method EPA 325 A/B, the new ruling calls for the installation of a passive monitoring system at the fenceline of all U.S. refineries by the end of 2017. Monitoring will be continuous and will require two-week sampling periods using a diffusive passive tube system that is housed in protective shelters set at specific intervals around a refinery's property line.[13]

What are the expected results? Based on EPA modeling, Method EPA 325 A/B will lead to a reduction of an estimated 52,000 tons per year of volatile organic compounds being emitted into the environment.[14] In the face of this major new environmental standard, we can all breathe a bit easier knowing that PerkinElmer's innovative technologies, operational effectiveness, and environmental expertise is available to help you become compliant.

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