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Gasoline risk management: A compendium of regulations, standards, and industry practices

Derek Swick^{a,*}, Andrew Jaques^b, J.C. Walker^c, Herb Estreicher^c^a American Petroleum Institute, 1220 L Street, N.W., Washington, DC 20005, United States^b RegNet, 1250 Connecticut Avenue, N.W., Suite 700, Washington, DC 20036, United States^c Keller and Heckman LLP, 1001 G Street, N.W., Suite 500W, Washington, DC 20001, United States

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ABSTRACT

This paper is part of a special series of publications regarding gasoline toxicology testing and gasoline risk management; this article covers regulations, standards, and industry practices concerning gasoline risk management. Gasoline is one of the highest volume liquid fuel products produced globally. In the U.S., gasoline production in 2013 was the highest on record (API, 2013). Regulations such as those pursuant to the Clean Air Act (CAA) (Clean Air Act, 2012: § 7401, et seq.) and many others provide the U.S. federal government with extensive authority to regulate gasoline composition, manufacture, storage, transportation and distribution practices, worker and consumer exposure, product labeling, and emissions from engines and other sources designed to operate on this fuel. The entire gasoline lifecycle—from manufacture, through distribution, to end-use—is subject to detailed, complex, and overlapping regulatory schemes intended to protect human health, welfare, and the environment. In addition to these legal requirements, industry has implemented a broad array of voluntary standards and best management practices to ensure that risks from gasoline manufacturing, distribution, and use are minimized.

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1. Introduction

Gasoline is a liquid fuel intended for use in spark-ignition, internal combustion engines and the U.S., gasoline production in 2013 was the highest on record (API, 2013). It is typically composed of hundreds of paraffinic, olefinic, naphthenic and aromatic hydrocarbons (generally referred to as PONA) refined from petroleum (crude oil) in the C4–C12 carbon-chain length range (API, 2008). In addition to the hydrocarbon base, gasoline also can contain a variety of blending components, such as oxygenates (e.g., alcohols, ethers). During gasoline manufacture, crude oil is fractionated, the fractions are chemically modified, and resulting refinery process “streams” are blended to meet specific physical and chemical property requirements (e.g., octane rating, sulfur limits, oxygen content, etc.), which comply with government regulations and industry performance and quality specifications. The property requirements, in turn, influence the chemical composition of gasoline.

This article summarizes current U.S. risk management measures for gasoline at selected stages in its lifecycle (see Fig. 1)—from the point where the gasoline is produced at a refinery, through its

delivery at the retail station pump, and concluding with its use as a motor fuel. It highlights both regulatory controls and current industry standards and practices during the lifecycle. The start and end points chosen for this analysis are appropriate for evaluating gasoline risk management from the viewpoint of a chemical regulatory framework. Accordingly, this analysis focuses on the management of gasoline, including:

- Registration requirements, including testing and formulation requirements, for gasoline, its components and additives;
- Controlling potential safety and environmental risks from gasoline during refining and distribution operations;
- Hazard communication and protecting occupational safety and health during manufacturing and handling operations; and
- Controlling potential risks of gasoline to end-users/consumers.

2. Regulation of gasoline and gasoline additives

Federal regulations administered by the U.S. Environmental Protection Agency (EPA) control the constituents in gasoline and the gasoline additives in order to minimize the environmental and public health consequences, and ensure proper performance when used as a motor fuel. Gasoline regulations may require the reduction of certain constituents (e.g., benzene) during refining,

* Corresponding author.

E-mail addresses: swickd@api.org (D. Swick), ajaques@regnet.com (A. Jaques), walker@khlaw.com (J.C. Walker), estreicher@khlaw.com (H. Estreicher).

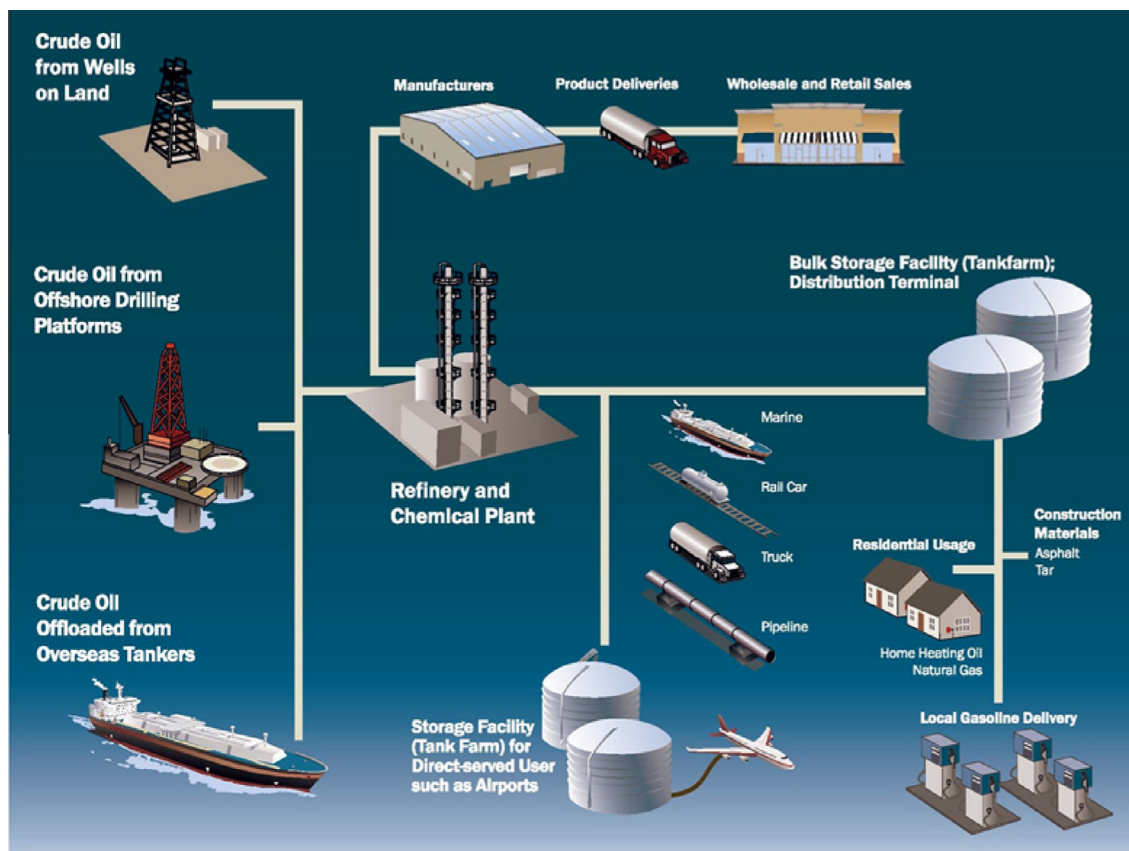


Fig. 1. The gasoline lifecycle.

or the inclusion of oxygenates and additives, such as detergents, prior to retail sale. Individual states may impose further, more stringent controls to address local air quality concerns. As a result of these layered requirements, the range of gasoline and additive formulations available for manufacture, distribution, and use is strictly controlled.

In addition to government regulations, industry contracting and purchasing specifications generally require that gasoline meet third-party voluntary performance and quality standards, such as those developed by the American Society for Testing and Materials (ASTM) International. As some standards are incorporated into state fuel quality regulations, these third-party standards effectively are mandatory. As gasoline must be used in, and subjected to, a wide variety of mechanical, physical, and chemical environments, its formulation must provide satisfactory engine performance over a wide range of operating conditions.

The Clean Air Act (CAA) ([Clean Air Act, 2012: § 7401, et seq.](#)) is the primary mechanism by which EPA may seek to “control or prohibit the manufacture, introduction into commerce, offering for sale, or sale” of any motor vehicle or non-road engine fuel or fuel additive if, in its judgment and after considering the available scientific and economic data, the Agency determines that a fuel, fuel additive, or their emissions could endanger public health or impair the operation of motor vehicle emission control devices ([Clean Air Act, 2012: § 7545\(c\)](#)). The CAA specifies criteria that gasoline must meet prior to retail sale, and prohibits the presence or use of certain constituents and mandates the addition of others to ensure gasoline presents minimal impact on human health and the environment.

EPA effectuates this mandate through its implementing “Fuels Regulations” found at 40 C.F.R., Parts 79 and 80. Any manufacturer or importer seeking to introduce gasoline or gasoline additives into

commerce must first register the product with the Agency. Depending on the type and nature of the gasoline or additive, the Agency may require an extensive battery of environmental fate and human effects testing as part of the registration process. In addition to the fuel registration requirements, over time EPA has regulated the properties of gasoline and gasoline additives in a number of ways such as the following (all of which are discussed in greater detail in Section 2.2):

- Banning the use of lead-containing additives in automotive gasoline;
- Requiring the use of detergent additives to prevent engine deposits;
- Regulating volatility (vapor pressure) to reduce evaporative emissions from gasoline;
- Limiting the average and maximum sulfur content of gasoline;
- Limiting the average and maximum benzene content of gasoline;
- Requiring the use of reformulated gasoline (RFG) in certain geographic areas; and
- Setting anti-dumping requirements that limit emissions of specified pollutants from gasoline.

2.1. Testing requirements for registration

Companies seeking to register gasoline or gasoline additives into U.S. commerce must submit to EPA a chemical description of their product, as well as technical, marketing, and health-effects information ([Registration of Fuels and Fuel Additives, 2013: § 79.51](#)). This information is intended to allow EPA to determine the likely combustion products and other emissions that may be released into the environment during the distribution, sale, and

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