

## **Total Reduced Sulfides**

The term “total reduced sulfides” has been historically, if inaccurately and inappropriately, used in reference to air emissions associated with pulp mills or the pulp operations at paper mills. Furthermore, the term “total reduced sulfides” is not used, and subsequently not defined, in either Oregon or federal laws or regulations.

The Oregon Department of Environmental Quality (DEQ) has adopted rules by administrative action under Oregon Revised Statutes (ORS) Chapter 468A covering various types of pulp mill emissions, including “total reduced sulfur (TRS).”

The rules are contained in Oregon Administrative Rules (OAR) 340-234. Section 234 is specifically applicable to “Emission Standards for Wood Products Industries,” and the definition of TRS under those rules is solely applicable to Kraft pulp mills.

The definition for TRS is stated in OAR 340-234-0010 (45): *“Total Reduced Sulfur (TRS)” means the sum of the sulfur compounds hydrogen sulfide, methyl mercaptan, dimethyl sulfide, and dimethyl disulfide, and any other organic sulfides present expressed as hydrogen sulfide (H<sub>2</sub>S).*

Other references to TRS are in OAR 340-234-0210 “Emission Limitations,” and deal specifically with various industrial operations at pulp/paper mills such as recovery furnaces, lime kilns, smelt dissolving tanks and other sources including, but not limited to, knotters and brown stock washer vents, brown stock washer filtrate tank vents, and black liquor oxidation vents. OAR 340-234-0240 “Monitoring” provides guidance for continuous monitoring of TRS.

In 2001, the U.S. Environmental Protection Agency (EPA) adopted regulations for “National Emission Standards for Hazardous Pollutants for Chemical Recovery Combustion Sources at Kraft, Soda, Sulfite, and Stand-Alone Semichemical Pulp Mills.” These regulations were adopted under the framework of the Federal Clean Air Act (FCAA) and are contained in the Federal Register, Volume 66, No. 139. The rules define procedures and formulae to be used by pulp/paper mills to determine compliance with federal air quality standards.

The Code of Federal Regulations (CFR) Title 40 deals with the regulation of and limits the emission of toxic air pollutants, including TRS. The majority of specific documents on the EPA website dealing with TRS refer primarily to Kraft pulp mills, however there are references to oil refinery operations and the removal of high levels of sulfur in crude oil, requirements for the removal of excessive levels of Hydrogen Sulfide (H<sub>2</sub>S) from natural gas, and H<sub>2</sub>S emissions from sewage treatment plants, landfills, leather tanning facilities and concentrated animal feeding operations.

## **Total Reduced Sulfur(s) (TRS)**

Total reduced sulfur(s), which include hydrogen sulfide (H<sub>2</sub>S), methyl mercaptan (methanethiol, CH<sub>3</sub>SH), dimethyl sulfide (CH<sub>3</sub>SCH<sub>3</sub>), and dimethyl disulfide (CH<sub>3</sub>S<sub>2</sub>CH<sub>3</sub>), occur naturally in the environment and can also be present in numerous industrial gaseous streams – petroleum refining, natural gas extraction, and chemical operations like the pulp/paper industry. Hydrogen sulfide is the most prevalent of the total reduced sulfurs, and is commonly found in volcanic gases, marshes and swamps, wetlands and mud flats, sulfur springs and decaying organic matter. Additionally, hydrogen sulfide is produced by living organisms, including human beings,

through the digestion and metabolization of sulfur-containing materials. It must be noted that sulfur dioxide (SO<sub>2</sub>), sulfur trioxide (SO<sub>3</sub>) and sulfuric acid mist are not included in the determination of TRS, as these are oxidized sulfur compounds and are permitted and monitored separately from TRS.

Oregon DEQ permits, and requires monitoring and reporting, of specific pollutants under the Federal Clean Air Act (FCAA) as defined under OAR 340-200-0020. The emission rates defined through the FCAA for hydrogen sulfide, TRS, sulfur dioxide, and sulfuric acid mist above which permits, monitoring and reporting are required are as follows:

Hydrogen Sulfide (H <sub>2</sub> S)	10 tons/year
Total Reduced Sulfur (TRS); including hydrogen sulfide	10 tons/year
Sulfur dioxide (SO <sub>2</sub> )	40 tons/year
Sulfuric Acid Mist	7 tons/year

**Hydrogen Sulfide as a Component of Petroleum and Natural Gas.** Hydrogen sulfide (H<sub>2</sub>S) is a naturally occurring chemical compound often found in hydrocarbon-bearing geological formations beneath the surface of the earth. These formations are the source of petroleum and natural gas.

During the refining of crude oil varying amounts of hydrogen sulfide are removed depending on the requirements of the finished product; heavy fuel/heating oil (Bunker C), home heating oil, diesel fuel, numerous grades of gasoline, and other refined products. Since these finished products are primarily used for energy production or industrial operations in some form and are most often consumed by some type of combustion process, there is little if any emission of hydrogen sulfide since the combustion process converts hydrogen sulfide to sulfur dioxide.

Additionally, natural gas removed from geological formations normally contains associated hydrocarbons such propane and butane (also known as natural gas liquids [NGL]), and impurities such as water, hydrogen sulfide, carbon dioxide, and other compounds. NGLs and the impurities are removed from “wellhead or raw” gas prior to the gas being transported in pipelines. Natural gas is often referred to as “sour” or “acid” if it contains either hydrogen sulfide or carbon dioxide respectively. Both compounds are removed prior to transport in pipelines because they are not safe for the environment or for living creatures in concentrations above specified regulatory levels and they can be corrosive to the metals used in pipelines. The gas distributed to industrial, commercial and residential users is almost pure methane. The most common standard for the allowable level of hydrogen sulfide in consumer natural gas is four (4) Parts Per Million (ppm)\*.

\*“Parts Per Million (ppm)” means parts of a contaminant per million parts of gas by volume on a dry-gas basis (1 ppm equals 0.0001% by volume). In reference to hydrogen sulfide, this volume can also be expressed as 5.7 milligrams of H<sub>2</sub>S per cubic meter of natural gas.

**Liquefied Natural Gas (LNG).** Natural gas is the feedstock for production of LNG, and the liquefaction process requires removal of all acid gases and sulfur compounds – carbon dioxide and hydrogen sulfide – prior to the compression and chilling process used to convert the gas to a super-chilled liquid held at -260° Fahrenheit. In some cases the associated hydrocarbons – butane, propane and others – remain a component of the super-chilled liquid and are removed

by a natural gas liquids (NGL) extraction plant at the LNG terminal prior to injection of the natural gas into a distribution pipeline.

### **Oregon International Port of Coos Bay Ordinance No. 129**

Port Ordinance No. 129 was adopted as an initiative measure with the title “Air and Water Limits on Future Transfers of Port Lands” by voters in the Port District on November 5, 1990, and amended and adopted February 6, 1991, by the Port’s Board of Commissioners. In essence Ordinance No. 129 states that “unless approved by vote of the people at a general or special election, the Port shall not hereafter lease, sell or transfer any of its property for a proposed industrial use which would be...”

- a single point source discharger of waste water... in excess of 2 million gallons per day... or which would use or divert in excess of 2 million gallons of fresh water per day...
- an air pollution source... which discharges or releases into the air one ton of total reduced sulfides per year...
- an air pollution source which releases into the air toxic chemicals in excess of state or federal standards...

The full text of Ordinance No. 129 is attached to this document and is also available at [www.portofcoosbay.com/ord129.pdf](http://www.portofcoosbay.com/ord129.pdf).

Additionally the Board of Commissioners established “a citizens committee to advise the Port on actions which the Port should take for breach of provisions in leases, deeds or transfer agreements relating to compliance with federal, state or local environmental laws and regulations.”

### **The Jordan Cove Energy Project**

The Jordan Cove Energy Project, L.P. is a proposed liquefied natural gas (LNG) bulk liquid marine receiving terminal, LNG storage tank facility and natural gas vaporization unit, which includes a small on-site natural gas-fired power plant to provide electric energy for the LNG facility and for distribution to the regional electrical grid when not required for LNG plant operations.

The Jordan Cove facility will receive LNG by deep-draft tanker at the receiving terminal and the LNG will be pumped to landside storage tanks. During the ocean voyage, boil-off gas (BOG) is captured on board the vessel via a vapor recovery system. The gas can be reliquefied and returned to the LNG storage tanks, held in on-board gas storage tanks or routed to the vessel drive engines and other power generating equipment and used as fuel. There are no emissions of natural gas, and therefore no emissions of any hydrogen sulfide. Heavy fuel oil, diesel fuel and natural gas, and any trace amounts of hydrogen sulfide combusted as fuel on board the vessel may result in trace emissions of sulfur dioxide.

At the landside operation LNG will be held in the full-containment storage tanks and then pumped to an LNG vaporization unit for conversion back to a gaseous state before being compressed and pumped into a natural gas pipeline for distribution in the regional gas pipeline grid. The LNG storage tanks have a BOG recovery system and natural gas captured in the system is immediately injected into the gas pipeline. There are no emissions of natural gas as

part of the vaporization process. Any natural gas used as fuel at the on-site power plant will be fully combusted, with the resulting emission – if there are any trace amounts of hydrogen sulfide in the natural gas – being sulfur dioxide.

### **Jordan Cove compliance with Port Ordinance No. 129**

The key to the Jordan Cove Energy Project (JCEP) compliance with Port Ordinance No. 129 is based on the specific language of Ordinance No. 129 as follows:

Port Ordinance No. 129 states that “unless approved by vote of the people at a general or special election, the Port shall not hereafter lease, sell or transfer any of its property for a proposed industrial use which would be...”

- an air pollution source... which discharges or releases into the air one ton of total reduced sulfides per year...
- an air pollution source which releases into the air toxic chemicals in excess of state or federal standards...

Since the LNG storage tanks and the natural gas vaporization unit do not allow for discharge or release into the air of one ton of total reduced sulfides per year or a release into the air of toxic chemicals in excess of state or federal standards, the proposed project fully meets the stipulations of Ordinance No. 129.

Additionally, specifically in reference to Port Ordinance No. 129 and generally in reference to compliance with all local, state and federal environmental laws and regulations now in force or which may come into force, there is language in the legal agreements between the Oregon International Port of Coos Bay and the Jordan Cove Energy Project requiring the “tenant,” Jordan Cove, to obtain, keep in force, and comply with all permits required for operation of the facility. Noncompliance with the terms of the agreement Attached to this document is Exhibit D-1 ~ D-2 8.5 Environmental Issues, which contains the specific stipulations of the legal agreements.

Air quality standards for the United States and for the State of Oregon are strictly controlled by the Federal Clean Air Act (FCCA), which is used to establish air quality and air emission standards that protect the environment and the health of citizens. In Oregon the Department of Environmental Quality (DEQ) is responsible for enforcing the FCCA and for issuing permits for projects that could potentially emit air emissions. The Jordan Cove project has worked with DEQ to establish air emission standards and protocols for the project and to create air emission modeling protocols. Those protocols have been accepted by DEQ and will be the basis for evaluating Jordan Cove’s permit applications. The permit application will identify all of the potential air emissions regulated by DEQ. Jordan Cove must meet all existing air quality standards in order to receive an operating permit from DEQ. A draft version of the Jordan Cove air emission application is available in JCEP Resource Report #9 – Air and Noise Quality. (Since Jordan Cove Resource Report #9 is 1081 pages, it is NOT attached; however it is available on-line through the FERC website or through the Jordan Cove website.)

Air emissions generated by the Jordan Cove project must be continuously monitored – by Oregon DEQ regulation – and audited by an independent third-party as a requirement of the DEQ air permit. This process will ensure compliance with the air emission stipulations in Port Ordinance No. 129.