

## TEDX

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### Products and Chemicals Used in Fracturing February 2009

TEDX (The Endocrine Disruption Exchange) has compiled a list of the names of products and their chemical constituents reportedly used during the fracturing of natural gas wells. Nalco<sup>1</sup>, World Oil<sup>2</sup> and J.D. Arthur<sup>3</sup> list the functional categories of these chemicals as follows:

- acids
- biocides
- breakers
- clay stabilizers
- corrosion inhibitors
- crosslinkers
- defoamers
- emulsifiers
- fluid loss control
- foamers
- fracturing fluids
- friction reducers
- gellants
- iron control
- non-emulsifiers
- pH control
- polymers
- proppants
- resins
- sand
- scale control
- solvents
- surfactants
- viscosifiers

TEDX's list includes the names of 435 fracturing products containing 344 chemicals as of February 2009. Information about the products and the chemicals they contain came from several states and a variety of sources including Material Data Safety Sheets (MSDSs), state Emergency Planning and Community Right-to-Know Act (EPCRA) Tier II reports, Environmental Impact Statement and Environmental Assessment Statement disclosures, rule-making documents, and from accident and spill reports, etc. The quantity and quality of information varied among these data sources. TEDX makes no claim that the following information is complete either in the scope of the products used during fracturing operations, or in the chemical composition of the products.

### ***PRODUCT ANALYSIS***

#### **Material Safety Data Sheets (MSDSs)**

MSDSs are designed to inform those who handle, ship, and use the product(s) about their physical and chemical characteristics, and their direct and/or immediate health effects in order to prevent injury while working with the product. The sheets are also designed to inform emergency response crews in case of accidents or spills. The total reported composition of a product on an MSDS can be less than 0.1% up to 100%. The health information on MSDSs most often warns of possible harm to the skin and eyes, gastrointestinal and respiratory tracts, followed by the nervous system and brain. Many MSDSs do not address the outcome of long term, intermittent, or chronic exposures, or adverse health effects that may not be expressed until years after the exposure. MSDSs are not submitted to the Occupational Safety and Health Administration (OSHA) for review. The product manufacturers determine what is revealed on their MSDSs.

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<sup>1</sup> List of fracturing products from Nalco, Upstream Petroleum/Natural Gas: Fracturing Additives, [http://www.nalco.com/asp/industries\\_served/upstream\\_petroleum/drilling/fracturing.asp](http://www.nalco.com/asp/industries_served/upstream_petroleum/drilling/fracturing.asp), Accessed on 11-24-08.

<sup>2</sup> World Oil, Fracturing products and additives – hydraulic fracturing of oil wells – Fracturing: A Well Completion Reference, [http://findarticles.com/p/articles/mi\\_m3159/is\\_/ai\\_21219369](http://findarticles.com/p/articles/mi_m3159/is_/ai_21219369), Accessed on 11-24-08.

<sup>3</sup> Arthur J.D., Bohm B., Coughlin B.J., Layne M. Evaluating the environmental implications of hydraulic fracturing in shale gas reservoirs. International Petroleum & Biofuels Environmental Conference, Albuquerque, NM. Nov 11-13, 2008.

Of the 435 products on TEDX’s list, 282 had an MSDS. Three of the MSDSs listed no ingredients, and 10 reported only “no hazardous ingredients” or “particulates not otherwise classified (PNOC).” Thirty-seven MSDSs listed at least one ingredient, but no CAS numbers<sup>4</sup>, and 19 of these MSDSs provided no percent of composition. Among the 232 MSDSs that listed at least one ingredient with a CAS number, 75 provided information on less than 50% of the total composition. Thirty-two MSDSs disclosed over 95% of the product ingredients and all the CAS numbers.

### **State Tier II Reports**

Information for 91 of the 435 products on the TEDX spreadsheet came from Tier II report data. Tier II reports must be filed by storage facilities under EPCRA. The Act sets a minimum amount above which a product containing a hazardous substance has to be reported in a storage facility. Reporting requirements vary from state to state, and the amount of information included on the form also varies from county to county and company to company. The descriptors on the forms received by TEDX ranged from a functional category name (e.g. surfactants, gellants, etc.) with no product name or no other chemical information, to the name of the product with specific chemical ingredients and CAS numbers. The percent of the total composition of the products is rarely included on these forms.

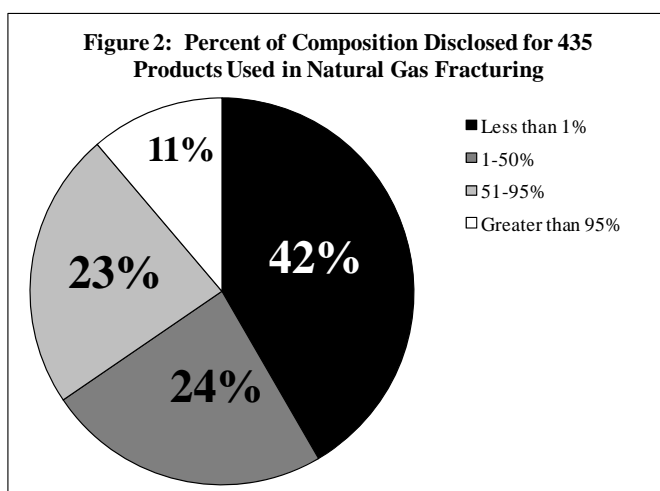
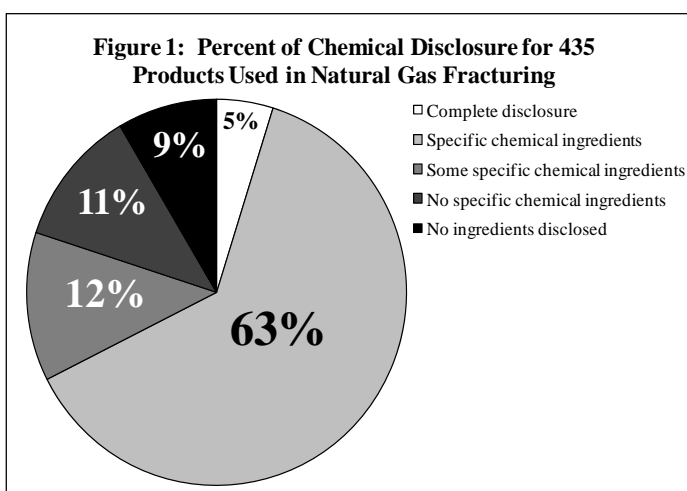
Thirteen of the products listed on Tier II forms did not provide any ingredients, while 68 listed one chemical. Ten products listed more than one ingredient, and three of these listed at least one unidentifiable (general) chemical name with no CAS number.

### **Other Sources of Information**

The remaining 62 products on the TEDX list came from a variety of sources mentioned above, with varying amounts of information, ranging from no information about product composition (12), to general chemical class name(s) (11), to at least one specific chemical name (39). The source of information on only two products in this category provided complete information on the specific chemical makeup and over 95% of the composition.

### **Evaluation of the information available about the 435 products**

Two hundred and seventy-three products (63%) have at least one chemical ingredient listed with a CAS number (Figure 1). Twelve percent of the products contain a combination of chemicals with and without CAS numbers, and 11% contain chemicals with only general or non-specific names. No information for 9% of the products was provided. The remaining 5% of the products disclose all of the ingredients.



<sup>4</sup> Chemical Abstracts Service number. This number is used to identify a specific chemical. A single chemical can have many different names, but only one CAS number.

Less than 1% of the total composition is known for 181 (42%) of the 435 fracturing products (Figure 2). Less than 50% of the composition is known for 24% of the products, and between 51% and 95% of the composition is known for 101 (23%) of the products. Eleven percent (49) of the products had information about more than 95% of their full composition.

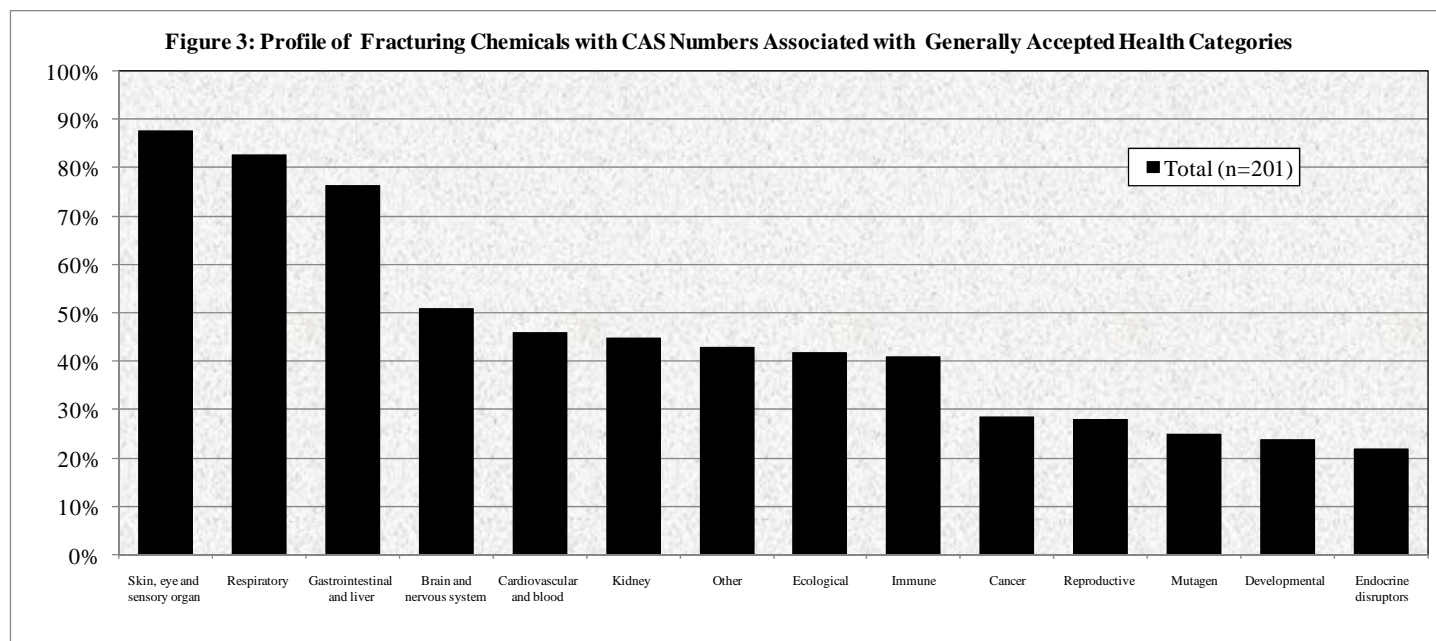
## ***CHEMICAL ANALYSIS***

### **Evaluation of the information available about the 344 chemicals**

Specific chemical names and chemical identification numbers (CAS numbers) could not be determined for 143 (42%) of the 344 chemicals on TEDX's list. The names of these chemicals were too general (e.g. latex base, surfactant, or polymer, etc.), or they were listed as "proprietary," "mixtures," "unspecified," "various," or "no hazardous ingredient."

For 56 of the 143 chemicals with no CAS number, it was impossible to link those chemicals to any health category aside from the health data reported on an MSDS if one was available. The limitations of MSDS data for possible health effects are noted above. Some health data was provided for another 8 chemicals, but for the remaining 79, no information could be found.

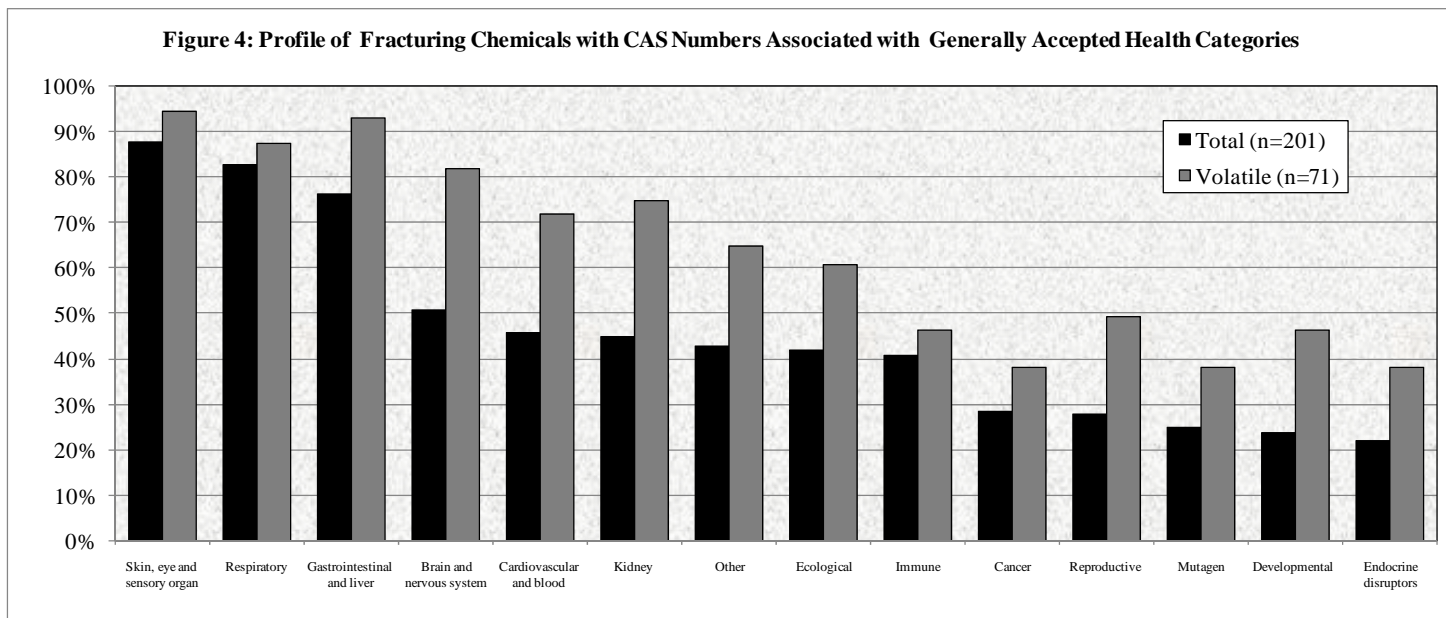
Figure 3 shows the percentages of the 201 chemicals with CAS numbers, which affect the general health categories used in government reports.



## ***FOR FURTHER CONSIDERATION***

- Full information about ingredients and composition was available for only 5% (21) of the 435 products on TEDX's list (Fig. 1). The identity of every chemical and how much of each is present in the container is needed to determine product safety. It is also necessary to know the exact chemical composition of the vehicle used to dissolve or suspend the chemical(s) and used to fill the product container to the brim.
- Twelve of the 21 products providing their complete formulation contained only one ingredient, such as starches, cellulose, or carbon, relatively harmless ingredients compared with other chemicals on the list.

- Air is the primary pathway of concern for fracturing chemicals. Ninety-six percent (281) of MSDSs provide a warning about eye and/or skin harm, 94% warn about respiratory system harm, and 49% warn about brain or neurological harm based primarily on inhalation and/or dermal contact.
- Sixty-five percent of the volatile chemicals for which TEDX has CAS numbers are associated with eight or more of the 14 generally accepted health categories used in government reports. Ninety-four percent are associated with skin, eye and respiratory harm, 93% with harm to the gastrointestinal system, 87% with respiratory system damage, and 83% with brain and nervous system effects (see Figure 4).



- Numerous products with ingredients that would ordinarily be considered benign have MSDSs that warn of the irritant nature of the chemical to the eyes, skin, and respiratory tract. In many instances these chemicals exist as fines or dusts.
- Gas field workers are most likely to be the first exposed to the chemicals used in fracturing, especially to air-borne fines, dusts and volatile compounds. As the chemicals disperse from the pad, those living in proximity to fracturing operations will also be exposed.
- A health monitoring program for gas field workers and near-by residents could now be established based on the consistent profile of health categories associated with chemicals used during natural gas operations.
- For reasons stated above, the list TEDX has compiled is limited. It still provides a glimpse of the kinds of materials that are being introduced into the environment where natural gas operations are taking place. It also demonstrates the need for full disclosure of the formulation of the fracturing fluid used at each stage and event. This would include the amount of each product used, and the total amount of all fluids. This information would provide a better estimate of the contents of what will be recovered and the concentrations of the chemicals in the waste streams above and below ground.