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Global Trade Restrictions and Related Compliance Issues Pertaining to Oil and Gas Production Chemicals

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Abstract

Compliance and regulatory issues are driving not only the cost of oil and gas production chemicals, but also the underlying technology, the pace of innovation, and the industry structure. Suppliers' response to the competitive, economic, and regulatory environment will determine their ability to supply innovative chemicals safely and legally in the future. A proper understanding of the industry dynamics is essential for executives and procurement professionals in the industry. The paper provides an overview of the history and current state of legislation and regulatory frameworks that affect the trade of oil and gas production chemicals such as demulsifiers, corrosion inhibitors, biocides, and scale inhibitors. It will explore and explain global compliance restrictions and issues such as the impact of legislation such as Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), harmonized tariffs, labeling requirements, and regulations on Persistent Organic Pollutants. Based on this foundation, it provides discrete conclusions and guidance to help users and buyers of oil and gas production chemicals establish stable and high-value supply chain relationships while complying with applicable regulations.

A New Era of Environmental Awareness and Regulation

The hazardous chemical supply chain has become an issue over the last 10 years as a broad trend toward sustainable development that extends several major legislative landmarks of the 1970s and 1980s.

In the 1970s and 1980s, a body of environmental legislation established the US Environmental Protection Agency (EPA) and Occupational Safety and Health Administration (OSHA), and laws such as SARA (Superfund Amendments and Reauthorization Act of 1986), RCRA (Resource Conservation and Recovery Act (RCRA), enacted in 1976), CERCLA (Comprehensive Environmental Response, Compensation, and Liability Act of 1980), and the Right-to-Know laws. [i]

More recently, the United Nations (UN)'s Sustainable Development division has led a charge toward a sustainable life-cycle approach to government policy-making. Other more recent movements reflecting societal consciousness around care for the environment have included the Waste Electrical and Electronic Equipment (WEEE) Directive (2003), the International Restriction of Hazardous Substances Directive (2006), and the UN's Year of Biodiversity (2010), among other initiatives such as organic local agriculture and widespread focus on climate change.

In 2010, two high-profile incidents, combined with deadlines on the earlier legislation, intensified scrutiny of safety and security in the oil and gas production supply chain. First, the Macondo disaster heightened public sensitivity to environmental issues at about at the same time as the first major deadline for registration of chemical substances affected by Registration, Evaluation, Authorisation of Chemicals (REACH). Second, a public outcry over possible health risks due to the fracturing fluids used heavily in shale plays resulted in an EPA subpoena that invoked TSCA, the Clean Water Act, and the RCRA to force public disclosure of certain formulations that would have previously been considered "trade secrets" or "proprietary ingredients." The convergence of long-term and near-term trends is resulting in a greater sense of the importance of public oversight and regulation, and in a drive to purge loopholes and exemptions from environmental legislation, for example by removing "grandfather" clauses and exemptions on the basis of business-sensitive confidential information.

The Need to Be Compliant

What do buyers and sellers of oil and gas production chemicals need to do to be compliant and safe? This paper recommends the following steps:

- Formalize a governance structure and recognize the complexity by designating a lead person in charge of compliance if you don't already have someone so designated.
- Determine your exposure.
- Decide which supply chain partner will be the lead registrant.
- Influence the shape of legislation for substances that are critical to you, especially ones that could become 'substances of very high concern' or equivalents on the TSCA Inventory List.
- Register the necessary chemicals by the stipulated deadlines.
- Update safety data sheets (SDS or MSDS) sheets.
- Update logistics and shipping formats to conform to new labeling standards.
- Minimize the cost of registration and compliance by using or developing greener substitute products for ones that would otherwise be classified as hazardous.

Before describing each step in detail, a clarification of the scope of "oil and gas production chemicals" is in order. The category covers a range of benign and potentially harmful chemical formulations, including the following types: [ii]

- Biocides
- Corrosion Inhibitors
- Scale Inhibitors
- Drag (Friction) Reducers
- Demulsifiers and Surfactants
- Proppants (sand and ceramic or glass)
- Acid Inhibitors (stabilize acid to stop it from reacting with orcorroding metal)
- Buffer (usually has an acid in it along with a basic material)
- Breaker (acids or enzymes to degrade polymer—primarily viscosity)
- Clay stabilizer (polymers to coat clay; salts including brines to stop clay from swelling)
- Liquid gel concentrate (viscosifier)
- Fluid loss control additive (particles like silica, or a mixture of polymers and particles, including fine sand and calcium carbonate).

Although not part of this scope, fracturing fluids similarly require careful environmental attention and could be subject to the new laws, so lessons learned from this paper may be applied to them. Halliburton's classification of "dangerous" substances in its disclosure of its fracturing fluid formulation revealed that only about half (56%) of the constituent chemicals were considered hazardous as determined by the listing on their Material Safety Data Sheets (MSDS), and many of those have commonplace uses. [iii] The conclusions of this paper generally applicable to those chemicals as well.

Formalize a Governance Structure

The REACH regulation (EC No 1907/2006) and the related UN Globally Harmonised System (GHS) are complex and will have widespread implications for most large companies and many small companies in the oil and gas industry. Shell estimates that the initial registration phase will address 4,000 high-volume chemicals in the petroleum industry, and that by 2018 30,000 substances will pass through the regulation. Across all industries, over 400,000 substances must ultimately be registered. It may sound trite, but it's very important early on to recognize the complexity and formalize a governance structure for grappling with the issues that will be presented, including appointing a lead person in charge of compliance if you don't already have someone so designated.

Determine Exposure and Possible Exemptions

First, determine if you buy, sell, or ship enough volume to be affected by the near-term deadlines. The IUCLID software, available through the European Chemicals Agency (ECHA), can be used to build a database of the chemical properties of all the substances and ingredients. For REACH (EU), determine the total amount of each substance used in the articles shipped to Europe that exceeds one metric ton. For TSCA (US), identify those for which you imported 10,000 pounds (4,540 kilos) or more at any site during the corporate fiscal year immediately preceding the reporting period. If you do, you need to register.

Second, determine if you qualify as a small importer. This would exclude you from the obligation to register if your total annual sales, combined with those of your parent company, domestic or foreign, are less than $40 million and your annual import volume is below 100,000 pounds (45,400 kilos) of any reportable substance. There are additional qualifications and rules available in the TSCA Inventory Rule.

Third, compile a substance inventory profile, starting with biocides and corrosion inhibitors. Biocides, corrosion inhibitors, and solvents are among the products affected by the recent European legislation. Biocides are widely addressed due to their wide scope of application – and chemical composition (23 types of applications, per REACH)[iv]. Even lower-risk categories will require registration, and if packaging and labeling is not correct, it won't ship.

Fourth, identify any chemicals that are "substances of very high concern." Some of the ingredients may be on ECHA's list of the Substances of Very High Concern (SVHC).[v] As examples, DEGME, DEGBE, cyclohexane, MDI, and ammonium nitrate (used primarily in paints and coatings) are SVHCs. Starting in June 2011, you must notify the European Chemicals Agency if you use more than one metric ton per year and the substance accounts for more than 0.1% of the mass of the object produced. Corrosion inhibitors are typically film-forming, so have toxicity issues. For example, a preliminary decision to add boric acid, sodium chromate, and lead sulfochromate yellow (C.I. Pigment Yellow 34) as SHVCs raised objections from industry representatives on the basis that these chemicals function as corrosion inhibitors, and trichloroethylene received similar objections on the basis of its use as a solvent. Furthermore, ECHA is expanding the SVHC list and it may soon include a substantial number of additional chemicals that could impact petroleum production beyond oil and gas production chemicals, for example in refining.[vi] Regardless of application, if you apply to use an SVHC, you must demonstrate how you will ultimately substitute its use with a safer alternative.

The US TSCA (Toxic Substances Control Act) and the proposed Safe Chemical Act of 2010 (which failed to pass in 2010 but will likely be reintroduced in 2011) similarly restrict, or are likely to restrict, the use of dangerous chemicals. The US has fewer blacklisted chemicals than the European – only nitrites appear to be on the EPA toxic substances control list, and then only of Group IA elements.[vii] – but the EPA periodically restricts additional toxic chemicals. It recently banned endosulfan and proposed restrictions on new use under TSCA on Hexabromocyclododecane (HBCD), Nonylphenol (NP), and Nonylphenol ethoxylates (NPEs). In addition, the US process's exclusions due to grandfathering and commercially sensitive information will be phased out as part of the Safe Chemical Act of 2010, which mandates a phased evaluation of all grandfathered substances and a priority list of 300 chemicals formerly grandfathered.

Fifth, determine what exemptions you may receive and which you may lose as a result of the new and upcoming legislation. The reduction of grandfathering exclusions and confidential business information exclusions, along with tight new criteria on impact assessments will undoubtedly make exemptions more difficult to get. By extension, new "green" (low bioaccumulation, high biodegradability, and low toxicity or sometime even sustainable) products are likely to be rejected if they are composed of the grandfathered materials. Moreover, applicants will need to demonstrate not only safe use in situ but safe use across the extended supply chain – a broad new test that may not stand in practice. Finally, regulators are likely to more closely scrutinize the use of pesticides and herbicides as "labels" for the same chemistries as biocides.

Decide Which Supply Chain Partner Will be the Lead Registrant

The main suppliers, as "Upstream Users" (manufacturers and importers), are knowledgeable about the legislation and some have been actively complying for years. Huntsman put out a memo as early as January 2009 announcing that it had completed pre-registration of nearly 2,000 substances for REACH. Champion set up a formal REACH team, and BASF used SAP for IT support. Ineos, a UK supplier, notified its customers that some of its products contained SVHCs.

Manufacturers are logical choices as the "lead registrant." The cost of compliance with REACH will favor larger suppliers, and may even factor into the decision-making for some more mergers. Although the industry is relatively concentrated, customers might accept more as long as they continue to benefit from end-to-end solutions and lower costs through economies of scale. REACH preparedness could be a factor in the valuation of potential acquisitions, as some top suppliers may break with longstanding competitive parity and some midsized suppliers may choose to accelerate their regulatory influence or take advantage of the deep pockets of major conglomerates that can share the overhead cost conformance across multiple holdings.

To become fully informed and possibly share the cost of registration, coordinate across the supply chain by joining a Substance Information Exchange Forums (SEIF) or industry consortium. These groups can also agree to assign a lead registrant and share the cost of registration. A study sponsored by ECHA found that a quarter of firms were not complying with registration due to the cost,[viii] which the Light Olefins and Aromatics Consortium (LOA) puts at 5-10,000 Euros per document. The LOA's members include companies like BASF, BP, and Shell Chemicals. The group expects to have registered 135 basic petrochemicals and plastics including benzene, butadiene, ethylene, polypropylene, polyethylene, toluene, and xylenes. LOA has spent $8m so far.

Influence the Shape of Legislation for Substances that are Critical to You

Although much of the legislation is complete, the existing laws are in some ways incomplete and inconsistent, and it will take years to iron out all the wrinkles. This will provide time for affected parties to lobby for interpretations and clarifications that favor them. For large companies that use substances that could become 'substances of very high concern' or equivalents on the TSCA Inventory List, this may be an opportunity rather than a problem.

While there is no leeway in Europe with REACH, the scope of “confidential business information” is still evolving in the US, and the whole concept of “confidential business information” has historically been more respected in the US than in Europe. The fact that data privacy has once been breached by mistake in Europe could provide ammunition for those seeking to protect confidential business information. The scope of clarification could play, for example, on exactly which fields of data are made publicly available, and when.

Incompleteness and inconstencies between REACH and the Biocide Directive will also offer a window of opportunity for users to influence the legal clarifications. The Biocide Directive leaves some unclear definitions and some unanswered questions. At a substantive level, the exact definition of an Endocrine Disruptor (ED) is still outstanding, and no criteria for defining it will be decided until 2013. At a procedural leel, the list of unspecified details includes exactly how to deal with low risk biocidal products, the criteria for exclusion (such as whether exclusion should be based on the use of the chemical or the chemical formulation itself), how to measure risk in the supply chain, and whether or not to have national approvals, and if so, what the role of ECHA will be in governing them or how it would be resourced to do so. Also, the exact grouping and classification of products into families and risk categories can make a big difference in the regulatory treatment of specific chemicals. Biocides have a partial exclusion from REACH, but the exclusion is tricky and internally inconsistent – a situation that requires legal resolution to avoid confusion, liability, and unsafe use. In brief, there will be ample opportunity for clarifications in the coming years.

The length of the review process – which will inevitably be extended – will allow time for those who have valid arguments to make them. The process of reviewing every chemical substance submitted – will be long and consultative, and will necessarily involve consultation with industry on many issues. With over 400,000 substances to eventually register across all industries, even the architecture of REACH’s master database is the subject of lengthy debate, and its administering it will be a business in itself. The US EPA has a similar challenge in its TSCA database and substance registration process.

Register the Necessary Chemicals by the Stipulated Deadlines

You need to register the required substances with ECHA. Over 140,000 non-phase-in substances were pre-registered by December 2008, and the deadline for high-volume and/or hazardous pre-registered phase-in substances passed in November 2010. Low risk biocides and lower-volume (from 100 to 1000 metric tons per year) substances, as well as new products, will need to be approved via a centralized procedure starting in 2013. The remaining products – mostly low-volume (below 100 metric tons per year), low environmental impact substances – must be registered starting in 2017. To register you will need to choose an “only representative,” which is sort of a local agent in the EU, in order to assure transparency of process, proper monitoring of the process, and recourse in the event of a failure of the first two.

You also need to register them with US EPA’s Substance Registry System (SRS), and these need to be updated every four years. The scope of SRS is to "compile, keep current, and publish a list of each chemical substance that is manufactured or processed in the United States.” However, it excludes pesticides since these are covered under a separate Federal Insecticide, Fungicide, Rodenticide Act (FIFRA).

Update Safety Data (SDS or MSDS) Sheets

You will need to change the format of Safety Data Sheets (SDS) or Material Safety Data Sheets (MSDS) sheets by replacing “Risk Phrases” in Section 15 with “Hazard Statements,” and “Safety Phrases” with “Precautionary Statements.” You will also need to use updated pictograms for labeling as well, and adhere to several new naming conventions.

Starting January 3, 2011, the Classification, Labelling and Packaging of chemical substances (CLP) (European regulation (EC) No 1272/2008) implements the Globally Harmonised System (GHS) in Europe. The CLP will replace the current Dangerous Preparations Directive (1999/45/EC) and the related Dangerous Substances Directive (Directive 67/548/EEC) in 2015. Article 5 classifies products as toxic; very toxic; category 1 or 2 carcinogen; category 1 or 2 mutagen; toxic for reproduction (category 1 or 2); to be placed on the market for professional use or not to be used by the general public; and not to be authorized for marketing to the general public. CLP applies to all REACH registrants, including “downstream users” (non-manufacturers).

Shipping is still to be governed by the hazard classes and divisions such as FAR 171-180 on hazardous goods for the US Department of Transportation (DOT) and appropriate corresponding agencies such as Transport of Dangerous Goods (TDG, Canada), Accord Européen Relatif au Transport International des Marchandises Dangereuses par Route (ADR, Europe), International Civil Aviation Organization (ICAO) and International Air Transport Association (IATA), and International Maritime Dangerous Goods Code (IMDG).

Develop Greener Substitute Products

One way to comply with a minimal cost of legal support and administrative debates over chemical classifications and exclusions, etc., is to completely eliminate hazards from the products. Approaches and technologies gaining popularity include "green" biocides, decontamination, short-lived biocides, and ultraviolet oxidation. Most focus has so far been on "green" biocides. At least four of the major manufacturers are providing low-environmental-impact clean stimulation formulations, each under different brand names. Decontamination processes range from solutions that focus on a specific trouble spot to full-scale water treatment and recycling of a whole ecosystem. One supplier has a patent application for a decontamination process involving nanoscale materials. Another is testing a new biocide that could become non-toxic in hours. Additional solutions that are being targeted at hydraulic fracturing promise to eliminate the use of most chemicals.

Conclusion

The hazardous chemical supply chain has moved from the background into the foreground, and achieved high visibility in 2010 as a result of the confluence of environmental movements and several unfortunate incidents. Legislators are scrutinizing safety and security in the oil and gas production supply chain, so users and suppliers of oil and gas production chemicals need to be compliant and secure. This paper provides a step-by-step process to assure safety and compliance. To reiterate the steps: 1) Recognize the complexity and designate a lead person in charge of compliance if you don't already have someone so designated; 2) Determine your exposure; 3) Decide which supply chain partner will be the lead registrant; 4) Lobby to influence the shape of legislation for substances that could become "substances of very high concern" or equivalents on the TSCA Inventory List; 5) Register the necessary chemicals by the stipulated deadlines; 6) Keep accurate safety data sheets (SDS or MSDS) sheets; 7) Update logistics and shipping formats to conform with new labeling standards; and 8) minimize the cost of compliance by developing greener products or process technologies.

Author's Note

This paper is based on the author's assessment of information available at the time of publication, and is not intended to be comprehensive, nor is it guaranteed to be free of error. It is assumed that readers will take proper care and due diligence to evaluate supply options, commensurate with the complexity and possible consequences of such decisions, including securing appropriate formal expert and legal opinions where appropriate. Boston Strategies International (BSI) does not assume any responsibility for omissions, errors, misprinting, or ambiguity contained, and shall not be held liable in any degree for any loss or injury caused by such omissions or errors.

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[i] Other more recent environmental legislation that could affect the petroleum industry, but is tangential to this report, includes the following:

- EPA Toxic Release Inventory (related to production, not movement)
- CEPA (Canadian Environmental Protection Act)
- Legislation on the protection of animals used in scientific experiments (86/609/EEC)
- Plant Protection Products Regulation
- European Food Safety Authority (EFSA)
- EC CFC (Chlorine-Fluorine-Carbons) Regulation (EC) No 2037/2000 on CFC regulation, affecting:
    - Chlorofluorocarbons;
    - Other fully halogenated chlorofluorocarbons;
    - Halons;
    - Carbon tetrachloride;
    - 1,1,1-trichloroethane;
    - Hydrobromofluorocarbons.

[ii] Below is a list of representative chemical formulations that could fall within each of the categories (per Dietz and other sources):

A. Biocides

B. Corrosion Inhibitors

1. Hexamine
2. Benzotriazole
3. Phenylenediamine
4. Dimethylethanolamine
5. Polyaniline
6. Sodium nitrite
7. Cinnamaldehyde
8. Condensation products of aldehydes and amines (imines), chromates, nitrites, phosphates, hydrazine, ascorbic acid
9. Acetylinic alcohol (a)
10. Polyphosphonohydroxybenzene sulfonic acid compounds (f)
11. Tall oil fatty acid anhydrides
12. 1-Hydroxyethylidene-1, 1-disphosphonic acid (g)
13. 3-Phenol-2-propyn-a-ol(PPO) (b)
14. 2-Hydroxyphosphono-acetic acid (h)
15. Dicyclopentadiene dicarboxylic acid salts(c)
16. Water-soluble 1,2-dithiol-3-thiones (i)
17. Hydroxamic acid Sulfonated alkylphenol (j)
18. Cyclohexylammonium benzoate
19. Polythioether
20. Acyl derivatives of tris-hydroxy-ethylperhydro-1,3,5-triazine
21. Thiazolidines
22. 2,4-Diamino-6-mercapto pyrimidine sulfate (DAMPS) combined with oxysalts of vanadium, niobium, tantalum or titanium, zirconium, hafnium
23. Substituted thiacrown ethers pendent on vinyl polymers
24. Aqueous alkanol amine solution (d)
25. Benzylsulfinylacetic acid or benzylsulfonylacetic acid
26. Quaternized fatty esters of alkoxylated alkyl-alkylene diamines
27. Halohydroxyalkylthio-substituted and dihydroxyalkylthio-substituted polycarboxylic acids (k)
28. Mercaptoalcohols
29. Alkyl-substituted thiourea
30. Polysulfide (e)
31. 2,5-bis(N-Pyridyl)-1,3,4-oxadiazoles

C. Fracturing Fluids - Hazardous Constituents

1. Formaldehyde

2. Phosphonic Acid, [[(phosphonomethyl)imino]bis[2,1-ethanediylnitrilobis(methylene)]]tetrakis-, Ammonium Salt
3. Alcohol C12-C16 Ethoxylated
4. Alcohol, C14-C15 Ethoxylate
5. 2,2 Dibromo-3-Nitrilopropionamide
6. 2-Monobromo-3-Nitrilopropionamide
7. 2-Propenoic Acid, Polymer with 2-Propenamide and Sodium 2-Propenoate
8. Acetic Acid
9. Acetic Anhydride
10. Ammonium Chloride
11. Cocamidopropyl Betaine
12. Crystalline Silica, Quartz
13. Guar Gum
14. Hemicellulase Enzyme
15. Hydrochloric Acid
16. Hydrotreated Light Petroleum Distillate
17. Isopropanol
18. Lactose
19. Methanol
20. Naphtha (Hydrotreated)
21. Naphtha (Hydrotreated)
22. Nitrogen
23. Potassium Carbonate
24. Propargyl Alcohol
25. Sodium Chloride
26. Sodium Persulfate
27. Terpenes and Terpenoids, Sweet Orange-Oil
28. Tributyltetradecylphosphonium Chloride

D. Scale Inhibitors:
1. 1-Hydroxyethylidene-1, 1-disphosphonic acid
2. Carboxymethylinulin
3. Carbonic dihydrazide, H2NNHCONHNH2 Polycarboxylic acid salts
4. Polyaminealkylphosphonic acid and carboxymethylcellulose or polyacrylamide
5. Phosphoric acid esters or rice bran extract
6. Polyacrylic acid and chromium Poly(phosphino maleic anhydride)
7. Polyacrylates (a)
8. N,N-Diallyl-N-alkyl-N-(sulfoalkyl) ammonium betaine copolymer (with Nvinyl pyrrolidone or acrylamide), diallylmethyltaurine hydrochloride (CH2=CH-CH2CL X CH3-HN-CH2-CH2-SO3Na)
9. Amine methylene phosphonate (b)
10. Aminotri(methylenephosphonic acid)
11. Phosphonomethylated polyamine
12. Polyaspartates
13. Oil soluble
14. Polyacrolein
15. Sulfonated polyacrylate copolymer Naphthylamine polycarboxylic acids
16. Tetrakis-hydroxymethyl-phosphonium sulfate
17. Phosphonic acid and hydrofluoric acid
18. Phosphonates
19. Tertiary amines (c)

E. Drag (Friction) Reducers: many are for crude oil systems
1. Divinylbenzene/1-hexene,1-octene,1-decene, and 1-dodecene (a)
2. C12 to C18 acryalte or methacrylate/ionic monomer (e)
3. Styrene/N-vinylpyridine
4. Tert-Butlystyrene/alkyl acrylate, acrylic acid or methacrylic acid
5. Ethene(-Olefins) (b)
6. Acrylamide-acrylate
7. Homo- or co-polymers that -Olefins (c) ?? poly alpha olefins??
8. Ultrahigh-molecular-weight polyolefin

9. Polyisobutene (d)
10. Styrene/methyl styrene sulfonate/Nvinylpyridine (NVP) (f)
11. (Meth) acrylic acid esters

F. Demulsifiers and Surfactants

1. Blends containing (1) tannin or amino methylated tannin, (2) a cationicpolymer(3)polyfunctinal amines, WiO
2. Polyalkylenepolyamides-amines Oiw,Wio
3. Copolymer of diallyldimethy ammonium chloride and quaternized amino alkylmethacrylates and (meth)acrylic esters (e.g.,2-ethylhexylacrylate), OiW
4. Fatty acid N,N-dialkylamides (c) OiW
5. Amphoteric acrylic acid copolymer OiW
6. Diamides from fatty amines (d) WiO
7. Branched polyoxyalkylene copolyesters OiW Polycondensates of oxalkylated fatty amine(d), OiW
8. Copolymer of esters of acrylic acid and the respective acids, methacrylic acid (a), WiO
9. Poly(diallyldimethyl ammonium chloride) OiW
10. Copolymer of polyglycol acrylate or methacrylate esters, OiW
11. Alkoxylated fatty oil
12. Poly(1-acryloyl-4-methyl piperazine and copolymers of 1-acryloyl-4-methyl piperazine quaternary salts with acrylamide quaternary salts, OiW
13. Oxalkylated polyalkylene polyamines WiO
14. Copolymers of acrylamidopropyltrimethyl ammonium chloride with acrylamide OiW
15. Crosslinked oxalkylated polyalkylene polyamines, OiW
16. Vinyl phenol polymers (b) OiW
17. Phenol-formaldehyde resins, modified with benzylamine (e)
18. Etholylated or epoxidized polyalkyleneglycol, WiO
19. Alkoxylated alkylphenol-formaldehyde resins, WiO
20. Polymers from dimethylaminoethyl methacrylate, dimethylaminopropyl methacrylamide, OiW
21. Phenol-formaldehyde polymer modified with ethylene carbonate, WiO
22. Polymer of monoallylamine OiW Modified phenol-formaldehyde resins
23. Copolymers of allyl-polyoxyalkylenes with acrylics, WiO
24. Polyalkylene polyamine salts OiW
25. Copolymer of diallyldimethyl ammonium chloride and vinyl trimethoxysilane, WiO
26. Dithiocarbamate of bishexamethylenetriamine, OiW
27. Cationic amide-ester compositions OiW
28. Di- and tri-dithiocarbamic acid compounds
29. Polythioalkyloxides WiO Sulfonated polystyrenes OiW
30. Polyether-polyurethanes WiO
31. Asphaltenes
32. Polyurea-modified polyethrurethanes WiO
33. Acid-modified polyol LS
34. Ethoxylated methylcarboxylates
35. Alkyl xylene sulfonates, polyethoxylatedalkyl phenols, octaethylene glycol mono ndecyl ether, and tetradecyl trimethyl ammonium chloride
36. Propoxyethoxy glyceryl sulfonate
37. Anionic sodium dodecyl sulfate (SDS), cationic tetradecyl trimethyl ammonium chloride (TTAC), nonionic pentadecylethoxylated nonylphenol(NP-15), and nonionic octaethylene glycol N-dodecyl ether
38. Alkylpropoxyethoxy sulfate as surfactant, xanthan, and a copolymer of acrylamide and sodium 2-acrylamido-2-methylpropane sulfonate
39. Dimethylalkylamine oxides as cosurfactants and viscosifiers
40. Carboxymethylated ethoxylated surfactants (CME)
41. (N-Dodecyl)trimethylammonium bromide
42. Polyethylene glycols, propoxylated/ethoxylated alkyl sulfates
43. Petrochemical sulfonate and propane sulfonate of an ethoxylated alcohol or phenol
44. Mixtures of sulfonates and nonionicalcohols
45. Petrochemical sulfonate and –olefin sulfonate
46. Combination of lignosulfonates and fatty amines

G. Fracturing Fluids - Non-Hazardous

1. 2-Propenoic Acid, Polymer with 2-Propenamide and Sodium 2-Propenoate

2. Acetophenone, Thiourea, Formaldehyde Polymer
3. Alpha Olefin Blend
4. Dimethyl Dihydrogenated Tallow Ammonium Chloride Reaction Product with Bentonite
5. Ethoxylated Fatty Acid
6. Fatty Acid Tall Oil Blend
7. Glycerin
8. Polyethyleneglycol Isotridecyl Ether
9. Sodium Chloride
10. Sodium Sulfate
11. Sorbitan Monooleate
12. Sorbitan Monooleate Ethoxylated
13. Tall Oil Acid Diethanolamide
14. Terpenes, Orange Oil Blend

H. Others

1. Acid Inhibitor (stabilize acid to stop it from being reactive to other things)
2. Buffer (usually has an acid in it)
3. Breaker (acids or enzymes to chew up polymer)
4. Clay stabilizer (polymers to coat the clay; brines)
5. Liquid gel concentrate
6. Fluid loss control additive (particles like silica, or a mixture of polymers and particles, including sand and calcium carbonate).
7. Proppant (sand and ceramic or glass)
8. Water

[iii] The chemicals used in fracturing, and their commonplace uses, according to Halliburton's disclosure website as a January 24, 2011, are:

Chemical	Commonplace Use
2,2 Dibromo-3-Nitrilopropionamide	Agricultural - Antimicrobial Agent
2-Monobromo-3-Nitrilopropionamide	Agricultural - Microbiocide Agent
2-Propenoic Acid, Polymer with 2-Propenamide and Sodium 2-Propenoate	Testing for Use as Drug Delivery**, Testing for Use in Textile Dye Removal**
Acetic Acid	Processed Fruit, Cheese, Meat and Poultry
Acetic Anhydride	Agricultural Microbiocide Agent
Ammonium Chloride	Hand Wash, Shampoo, Breakfast Cereal
Cocamidopropyl Betaine	Shaving Gel, Facial Cleanser, Shampoo, Car Wash Detergent
Crystalline Silica, Quartz	Hand Cleaner, Laundry Cleaner, Cat Litter
Guar Gum	Herbal Supplements, Fruit Jelly, Beer and Malt Beverages, Mustard
Hemicellulase Enzyme	Laundry Liquid Detergent, Dishwasher Detergent
Hydrochloric Acid	Table Olives, Unripened Cheese, Cottage Cheese
Hydrotreated Light Petroleum Distillate	Oil Wood Stain, Air Freshener, Surface Cleaner Aerosol
Isopropanol	Tape Head Cleaner, Hops Extract used for Beer, Air Freshener
Lactose	Anti-Wrinkle Treatment, Some Baking Soda, Anti-Inflammatory Medication
Methanol	Furniture Refinisher, Liquid Hand Soap, Windshield Washer Concentrate
Naphtha (Hydrotreated)	Paint Thinner, Surface Cleaner, Car Wax
Naphtha (Hydrotreated)	Paint Thinner, Surface Cleaner, Car Wax
Nitrogen	Salad Dressing, Frozen Fish Sticks, Infant Formula, Saline Eye Spray
Potassium Carbonate	Photo-Developing Agent, Whey Products, House Plant Fertilizer
Propargyl Alcohol	Cement and Grout Cleaner, Industrial / Commercial Metal Cleaner
Sodium Chloride	Laundry Detergent, Food Grade Salt, Volume Shampoo
Sodium Persulfate	Hair Dye, Industrial - Circuit Boards / Metal Cleaner
Terpenes and Terpenoids, Sweet Orange-Oil	Commercial Bathroom Disinfectant Cleaner, Dishwashing Detergent, Multi-surface Cleaner
Tributyltetradecylphosphonium Chloride	Restricted to Laboratory or Scientific Use Only

[iv] The 23 types of biocide applications, as defined by REACH, are:

Product-type 1: Human hygiene biocidal products
Product-type 2: Private area and public health area disinfectants and other biocidal products
Product-type 3: Veterinary hygiene biocidal products
Product-type 4: Food and feed area disinfectants
Product-type 5: Drinking water disinfectants
Product-type 6: In-can preservatives
Product-type 7: Film preservatives
Product-type 8: Wood preservatives

Product-type 9: Fibre, leather, rubber and polymerised materials preservatives
Product-type 10: Masonry preservatives
Product-type 11: Preservatives for liquid-cooling and processing systems
Product-type 12: Slimicides
Product-type 13: Metalworking-fluid preservatives
Product-type 14: Rodenticides
Product-type 15: Avicides
Product-type 16: Molluscicides
Product-type 17: Piscicides
Product-type 18: Insecticides, acaricides and products to control other arthropods
Product-type 19: Repellents and attractants
Product-type 20: Preservatives for food or feedstocks
Product-type 21: Antifouling products
Product-type 22: Embalming and taxidermist fluids
Product-type 23: Control of other vertebrates

[v] Others on ECHA's list of the Substances of Very High Concern (SVHC) include, at the time of research for this paper:

1. Disodium tetraborate
2. Tetraboron disodium heptaoxide
3. Potassium dichromate
4. Ammonium dichromate
5. Potassium chromate
6. 2 Acrylamide
7. Aluminosilicate Refractory Ceramic Fibres
8. Anthracene oil
9. Diisobutyl phthalate
10. Lead chromate
11. Lead chromate molybdate sulphate red (C.I. Pigment Red 104)
12. Pitch
13. Tris(2-chloroethyl)phosphate
14. Zirconia Aluminosilicate Refractory Ceramic Fibres
15. 4 5-tert-butyl-2
16. Alkanes
17. Anthracene
18. Benzyl butyl phthalate (BBP)
19. Bis (2-ethylhexyl)phthalate (DEHP)
20. Bis(tributyltin)oxide (TBTO)
21. Cobalt dichloride
22. Diarsenic pentaoxide
23. Diarsenic trioxide
24. Dibutyl phthalate (DBP)
25. Hexabromocyclododecane (HBCDD) and all major diastereoisomers identified:
26. Lead hydrogen arsenate
27. Sodium dichromate
28. Triethyl arsenate
29. Cobalt(II) sulphate
30. Cobalt(II) dinitrate
31. Cobalt(II) carbonate
32. Cobalt(II) diacetate
33. 2-Methoxyethanol
34. 2-Ethoxyethanol
35. Chromium trioxide
36. Chromic acid

[vi] The European Chemicals Agency (ECHA) is consulting stakeholders over proposals to identify 11 chemicals as Substances of Very High Concern (SVHCs) and possible candidates for authorization and restrictions under the EU's REACH chemical regulation. Currently the list of candidates includes:

1. 1,2,3-Trichlorobenzene--PBT like substance (equivalent level of concern). Uses are believed to be the same as for 1,2,4-Trichlorobenzene;
2. 1,2,4-Trichlorobenzene--PBT like substance (equivalent level of concern). There is a restriction in force prohibiting the placing on the market or use as a substance or in mixtures in a concentration = 0.1% except for use as an intermediate for synthesis and as a process solvent in closed systems. Mainly used as an intermediate and as a process solvent in closed systems. The substance may occur in imported articles;
3. 1,3,5-Trichlorobenzene--PBT like substance (equivalent level of concern). Uses are believed to be the same as for 1,2,4-Trichlorobenzene;
4. Cobalt(II) diacetate--CMR (carcinogen, cat. 2; toxic for reproduction, cat. 2). Mainly used in the manufacture of catalysts. Minor uses may include production of other chemicals, surface treatment, alloys, production of pigments, dyes, rubber adhesion, and feed additive;
5. 2-Ethoxyethanol--CMR (toxic for reproduction, cat. 2). Mainly used as solvent and chemical intermediate;
6. Chromium trioxide--CMR (carcinogen, cat .1; mutagen, cat. 2). Used for metal finishing and as fixing agent in waterborne wood preservatives; and
7. Acids generated from chromium trioxide and their oligomers: chromic acid, dichromic acid, oligomers of chromic acid and dichromic acid - CMR (carcinogen, cat. 2). These acids and their oligomers are generated when chromium trioxide is dissolved in water. Chromium trioxide is mainly used in the form of aqueous solutions. Consequently, the uses of these substances are the same as indicated for chromium trioxide.

[vii] EPA's toxic substances inventory contains over 80,000 substances, and the following substances are subject to export notification:

1. Alkylamine tetrachlorophenate
2. Fluoropolymer
3. Fluoropolymer composites
4. Fluorotelomer-Based Polymer Composites
5. Hexavalent chromium water treatment chemicals
6. Lead- and zinc-containing fishing sinkers
7. Nitrites of Group IA elements
8. Paper mill sludge
9. Perfluoroalkyl sulfonates (PFAS)
10. Polybrominated diphenyl ethers (PBDE's)
11. Polychlorinated biphenyls (PCB's)
12. Tetrabromobisphenol B

[viii] Chemical Week, May 31 2010.