Phenol and Phenolic Compounds

in Massachusetts

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I. Project Summary

Phenol and its related phenolic compounds, such as nonylphenol and nonylphenol ethoxylates, are widely utilized chemicals which, despite having noted negative effects on both people and the environment at large, are not heavily monitored with the current structure of chemical reporting. Working under the guidance of the Toxic Use Reduction Institute of the University of Massachusetts - Lowell (TURI), the goal of my project was to compile a profile of phenol in its uses, production, and locations across the state of Massachusetts to further improve reporting and thus aid in developing strategies to decrease its usage. Primarily utilizing data from the submission of 2017 Tier II forms, as required under Section 312 of the Emergency Planning and Community Right-to-Know Act of 1986, and 2016 Chemical Data Reporting entries, as required under Section 8(a) of the Toxic Substances Control Act of 1976, I was able to identify the at large composition of phenolic compounds, general trends in their utilization, and possible inconsistencies in submitted reports across the Commonwealth of Massachusetts.

II. An Introduction to Phenolic Compounds

A. Phenol

Phenol, also known as carbolic acid, hydroxybenzene, monohydroxybenzene, phenyl alcohol, phenyl hydroxide, and phenic acid, has the chemical structure of C_6H_5OH or C_6H_6O.[1] While it may have multiple chemical names, its unique corresponding Chemical Abstract Service registry number is 108-95-2 and is both a manufactured and naturally occurring substance.[2] As for its physical description, reports vary with the Center for Disease Control (CDC) reporting it

[1] "Phenol," Centers for Disease Control and Prevention (The National Institute for Occupational Safety and Health (NIOSH), June 22, 2019), https://www.cdc.gov/niosh/topics/phenol/default.html.
[2] "Phenol," National Center for Biotechnology Information. PubChem Compound Database (U.S. National Library of Medicine), accessed December 18, 2021, https://pubchem.ncbi.nlm.nih.gov/compound/phenol.

primarily has a colorless to light-pink appearance whereas the National Institutes of Health's National Library of Medicine (NIH) classifies phenol as being primarily colorless to white.[3] Further slight deviations in its description are apparent with the CDC describing phenol as a crystalline solid, the NIH referring to phenol in a commercial liquid form, and the New Jersey Department of Health, in a published hazardous substance fact sheet, referring to a combination of both.[4] Additionally, phenol is known for having a sweet, acrid, or almost tarry scent and is additionally noted as having a high solubility and the potential to be largely flammable.[5]

1. Uses of Phenol

Phenol is a fundamental component in a multitude of industrial processes with some of its primary uses being the production of phenolic resins, an intermediary in industrial processes, and its utilization in various medicinal aspects.[6] Phenolic resins are also utilized in construction, the production of plywood or fiberglass, and are frequently employed by the automotive, aerospace, and construction industries.[7] Phenolics also allow for the polymerization of a material via impregnation with thermosetting resins which make them a popular alternative to acrylics due to their comparatively higher tolerance to flexing.[8] Phenol is used in the industrial production of caprolactam and bisphenol A which leads to the manufacturing of both nylon and epoxy resins which are popular items across the general market.[9] As for medicinal industries, phenol is most

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[3] "Phenol," Centers for Disease Control and Prevention, 2019; "Phenol," National Center for Biotechnology Information. PubChem Compound Database.

[4] Ibid; "Right to Know Hazardous Substance Fact Sheet - Phenol," New Jersey Department of Public Health, August 2015, https://nj.gov/health/eoh/rtkweb/documents/fs/1487.pdf.

[5] "Phenol Report," Environmental Protection Agency, accessed December 18, 2021, https://beta.epa.gov/sites/default/files/2016-09/documents/phenol.pdf.

[6] "Phenol," Centers for Disease Control and Prevention, 2019.

[7] Ibid.

[8] "Phenolics Nylon Reinforced," Emco Plastics, accessed December 18, 2021, https://www.emcoplastics.com/phenolics-nylon-reinforced/.

[9] "Phenol, Acetone & Cumene," Petrochemicals Europe, June 9, 2021, https://www.petrochemistry.eu/sector-group/phenol-acetone/.

commonly utilized in slimicides, antiseptics, and disinfectants, as well as in ear and nose drops, throat lozenges, and mouthwashes.[10] A 1980 estimate from the Hazardous Substance Data Bank projected that the consumption of phenol as an intermediary was primarily for phenolic resins (43%) with bisphenol A (20.9%) and caprolactam (17%) representing the second and third largest categories with xylenols (6.8%), nonylphenol (2.7%), adipic acid (1.8%), O-hydroxybenzoic acid (1.3%), dodecylphenol (1.1%), along with various other materials (5.4%) representing a much smaller share of its market applicability .[11] While an outdated statistic, the general trends it conveys are still relevant with the exception of the rise in production of nonylphenol and nonylphenol ethoxylates, with a 2010 EPA report estimating US annual demand to be over 380 million pounds for nonylphenol compounds.[12] National aggregate production values for phenol compounds, as conveyed in the EPA's 2016 Chemical Data Reporting dataset, are estimated to be between 1,000,000,000 and 5,000,000 pounds annually.

2. Health Effects of Phenol

Phenol is classified by the Environmental Protection Agency (EPA) as a Group D substance which means that it is not classifiable as a human carcinogen with the specification that this conclusion comes "without adequate data either to support or refute human carcinogenicity."[13] Exposure to phenol is known to irritate the skin, eyes, nervous system, and mucous membranes within the sinus system such as the nose and throat, with oral ingestion or

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[10] "Phenol," National Center for Biotechnology Information. PubChem Compound Database.
[11] Ibid.
[12] "Nonylphenol (NP) and Nonylphenol Ethoxylates (NPEs) Action Plan," Environmental Protection Agency, September 2015, https://www.epa.gov/sites/default/files/2015-09/documents/rin2070-za09_np-npes_action_plan_final_2010-08-09.pdf.
[13] "Phenol Report," Environmental Protection Agency, 2016; "Risk Assessment for Carcinogenic Effects," Environmental Protection Agency, accessed December 18, 2021, https://www.epa.gov/fera/risk-assessment-carcinogenic-effects.

inhalation being highly toxic.[14] Symptoms of exposure normally present themselves as weight loss, weakness, exhaustion, and muscle aches and general pains.[15] Exposure to phenol is also known to produce damage to the liver and kidneys, epidermal burns, tremors, convulsions, adn twitching, with the severity of consequences varying on the duration and level of exposure but presenting itself as a more serious threat to workers in related industries who potentially face daily exposure.[16]

B. Nonylphenol and Nonylphenol Ethoxylates

Distinct from phenol, but still phenolic compounds, are nonylphenol (NP), and nonylphenol ethoxylate (NPE). NPEs are a derivative from phenol with a 9 carbon tail and hydroxyl group substituted into a benzene ring, distinct from phenol's substitution of only a hydroxyl group into their benzene ring.[17] NPES are also under the larger phenolic compound classification umbrella of alkylphenol ethoxylates (APES), comprising 85% of all APES by volume, due to their presence as surfactant compounds.[18] NPEs and NPs are both produced industrially on large scales which has been noted to lead, especially for NPs, to their widespread presence in aquatic environments.[19] This persistence poses long term concerns over ecosystem conditions as the less soluble nature of the chemical leads to a persistent presence that is mildly bioaccumulative.[20]

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[14]"Phenol," Centers for Disease Control and Prevention, 2019
[15]"Phenol Report," Environmental Protection Agency, 2016.
[16] Ibid.
[17] "Nonylphenol Ethoxylates," United States Department of Agriculture, January 29, 2015, https://www.ams.usda.gov/sites/default/files/media/Mox%20Technical%20Evaluation%20Report%20%282015%29.pdf.
[18] "Nonylphenol (NP) and Nonylphenol Ethoxylates (NPEs) Action Plan," Environmental Protection Agency, 2015.
[19] Ibid.
[20] Ibid.

NPEs are clear, orange, oily liquids, and are primarily classified to be fairly unreactive and stable chemicals.[21] The solubility of NPEs has been denoted to correlate strongly with the degree of its ethoxylation.[22] NPs, on the other hand, tend to be a clear, pale yellow substance with high viscosity, liquid state at room temperature, and a moderate volatility that some studies have shown can lead to significant atmospheric concentrations that degrade rapidly displaying short persistence in the air.[23] Quantities of NP in the environment are generally products of the environmental degradation of NPEs with environmentally present NPEs primarily entering the environment via sewage treatment.[24] This sewage runoff process is where a majority of NPEs experience biodegradation, sometimes a product of light exposure, which results in the production of NPs and short-chain NPES; both of which possess much greater resistance to further degradation and thus higher rates of long term persistence.[25] Regarding their ability to biodegrade, conflicting studies convey that while they are not readily biodegradable substances, they are inherently biodegradable in form.[26]

1. Uses of NPs and NPEs

NPEs are nonionic surfactants which are primarily utilized in a variety of industrial and commercial processes. These have been known to include the sectors of laundry detergents, personal hygiene, automotive operations, latex paint, and lawn care; all of which present an eminent threat of entry into aqueous environments and are result of the current persistence of

[21] Ibid.
[22] Ibid.
[23] Ibid.
[24] Ibid.
[25] Ibid.
[26] Ibid.

NPs in water bodies.[27] The primary use of NPs in industrial processes is as an intermediary in the production of NPEs where NPs undergo a reaction with ethylene oxide to produce NPEs.[28] While the utilization of NPEs in detergents has been phased out as awareness of its implications become more documented, it remains prevalent in a variety of industrial processes where it is utilized as a working fluid in metal working and petroleum industries and a component in manufacturing a variety of coating materials.[29] Other common uses of NPEs are documented in the textile, paper, indoor pesticide, cosmetic, and plastic recreational device industries.[30] In 2007, US and Canadian consumption of NPE surfactants was estimated to be between 300 to 400 million pounds per year.[31]

2. Health Effects of NPs and NPEs

One of the largest concerns regarding the negative implications of the use of NPs and NPEs are their bioaccumulation and persistence, especially in the context of aqueous environments.[32] NPs and NPEs already present in bodies of water or landfills could have potential long term consequences for groundwater.[33] The challenges of biodegradation have additionally demonstrated that moderate bioaccumulation of NP is possible in aquatic organisms.[34] The bioconcentration factor (BCF) for fish remains in a relatively low range, EPA reports as early as 1996 have displayed BCF values for mussels crossing into moderate

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[27] "Fact Sheet: Nonylphenols and Nonylphenol Ethoxylates," Environmental Protection Agency, accessed December 18, 2021, https://www.epa.gov/assessing-and-managing-chemicals-under-tsca/fact-sheet-nonylphenols-and-nonylphenol-ethoxylates.
[28] "Nonylphenol (NP) and Nonylphenol Ethoxylates (NPEs) Action Plan," Environmental Protection Agency, 2015.
[29] "Get the Facts: NPEs (Nonylphenol Ethoxylates)," Safer Chemicals Healthy Families, June 26, 2019, https://saferchemicals.org/get-the-facts/toxic-chemicals/npes-nonylphenol-ethoxylates/.
[30] Ibid.
[31] "Nonylphenol (NP) and Nonylphenol Ethoxylates (NPEs) Action Plan," Environmental Protection Agency, 2015.
[32] Ibid.
[33] Ibid.
[34] Ibid.

thresholds.[35] This persistence in bioaccumulation has been further denoted with NPs having been detected in human breast milk, blood and urine.[36] Acute exposure to NPs has denoted a low consumption toxicity but displayed high levels of irritance to the skin and eyes upon exposure.[37] While yet to be reflected in humans, extended exposure to NPs has been associated with serious reproductive and developmental implications for rodents.[38]

III. Reporting Systems and Relevant Legislation

After having recognized the structure, uses, and hazards of phenols, NPs, and NPEs, it becomes necessary to introduce and cover the pertinent reporting systems and related legislation that enable us to monitor and track these chemicals with their noted and prevalent detrimental aspects. Primarily, two of the most impactful pieces of legislation are the Emergency Planning and Community Right-to-Know Act and Toxic Substances Control Act which have led to the establishment of Tier II and Chemical Data Reporting datasets; both of which were heavily utilized in analyzing phenolic compounds within Massachusetts.

A. EPCRA - Section 312

Enacted in 1986, the Emergency Planning and Community Right-to-Know Act (EPRCA), was established with the agenda of ensuring that communities had recorded data surrounding the environmental and safety hazards associated with the storage, usage, and releases of toxic chemicals in their area.[39] EPCRA legislative points were primarily targeted at ensuring a

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[35] Ibid.
[36] "Fact Sheet: Nonylphenols and Nonylphenol Ethoxylates," Environmental Protection Agency.
[37] Ibid.
[38] Ibid.
[39] "What Is EPCRA?," Environmental Protection Agency, accessed December 18, 2021, https://www.epa.gov/epcra/what-epcra.

community had the ability to prepare safety protocols directly associated with addressing the potential hazards of toxic substances within their proximity.[40] Thus, under Section 312 of the EPCRA, all quantities of prespecified chemicals which cross their corresponding reportable quantity threshold (RQ) or threshold planning quantity (TPQ) must be submitted to the EPA via a Tier II form.[41] RQ represents the maximum amount of a substance that can be released into the environment without needing to file a report whereas the TPQ represents the minimum stored quantities of a substance allowed without also having to file a Tier II form.

The Extremely Hazardous Substances List provides the federal standards of what chemicals are pertinent under Section 312 of the EPCRA and thus which chemicals require Tier II forms.[42] NP and NPE notably lack standards on this list which presents a general concern regarding RQs as they have a clearly denoted negative impact with their emittance into the environment. Phenol, along with other variants of its compounds, is listed and denotes an RQ of 1,000 pounds and a TPQ of 500 pounds for powdered phenol and 10,000 pounds for liquid phenol.[43]

B. TSCA

The Toxic Substances Control Act (TSCA) of 1976 was passed by the 94th United States Congress and was fundamental for providing the EPA with the authority to require the reporting, recording, testing protocols, and restrictions related to various chemical substances.[44] The

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[40] Ibid.

[41] "Tier II Forms and Instructions," Environmental Protection Agency, accessed December 18, 2021, https://www.epa.gov/epcra/tier-ii-forms-and-instructions.

[42] "ECFR :: 40 CFR Part 355 -- Emergency Planning and Notification," Code of Federal Regulations (United States National Archives), accessed December 18, 2021, https://www.ecfr.gov/current/title-40/chapter-I/subchapter-J/part-355.

[43] Ibid.

[44] "Summary of the Toxic Substances Control Act," Environmental Protection Agency, accessed December 18, 2021, https://www.epa.gov/laws-regulations/summary-toxic-substances-control-act.

enactment of TSCA provided the foundation necessary for the subsequent enactment of the EPCRA. Under TSCA, firms were required to provide the EPA with reports on their chemical usage and allow access to their facilities for inspection to measure their compliance with relevant regulations. Regarding the status of chemical data, and specifically phenolic compounds in Massachusetts, two of the most critical sections of TSCA were Section 5(a) and Section 8(a) respectively.

1. Section 5(a)

Section 5(a) of TSCA established the protocol of Significant New Use Rules (SNURs). Generally put, SNURs require firms to notify the EPA before a chemical substance or mixture is utilized in a new way that has potential to pose concerns. In order for the EPA to classify a procedure as having been a significant new use, the determinants factors of projected substance volume, extent in changes in exposure form, alterations in scale of exposure, the anticipated accompanying methods of manufacturing, processing, distribution, and disposal must be thoroughly considered.[45] SNURs are fundamental for determining the future of a chemical substance's data reporting and are a critical topic regarding NPs and NPEs which have their respective thresholds absent from the aforementioned Extremely Hazardous Substances List.

2. Section 8(a)

Section 8(a) of TSCA established the protocol of Chemical Data Reporting (CDR) which is the law granting EPA the authority to require processors of chemical substances to maintain records which are then reported to the EPA. This information typically requires specification of

[45]"Actions under TSCA Section 5," Environmental Protection Agency, accessed December 18, 2021, https://www.epa.gov/reviewing-new-chemicals-under-toxic-substances-control-act-tsca.

chemical mixture, listed usage categories, produced or manufactured quantities, description of product, noted effects regarding health and the environment, number of individuals exposed, and methods of disposal.[46] Due to the scale of these reports, they are only required every four years with the threshold quantity of production for reporting remaining at 25,000 pounds per reporting year unless otherwise specified.[47] NPs and NPEs remain unspecified as a chemical substance in need of reporting under CDR regulations, a product of a lack of implemented SNURs. As for phenol, it is not specified as having a different threshold thus its reporting quantity is 25,000 pounds. However, under 2020 TSCA Instructions for Reporting, Appendix C, which refers to Chemical Substances Partially Exempt from Reporting, phenol mixtures associated with petroleum (CAS 64743–03–9) and phenol mixtures associated with sodium salts, sulfur compounds, gasoline, and alkyl scrubber residues (CAS 68988–99–8) are both listed.[48]

IV. Examining Massachusetts Phenol Reporting

The datasets provided as a product of Tier II and CDR records are integral to accessing the status of a chemical substance. While the reporting of NPs and NPEs are not specifically emphasized by legislation tied to reporting thresholds, phenol's Tier II RQ of 1,000 pounds, TPQ of 500 pounds as a solid, TPQ of 10,000 pounds as a liquid, and CDR threshold of 25,000 pounds convey critical information on the status of phenol in Massachusetts.

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[46] "Legislative and Regulatory Authority for Chemical Data Reporting," Environmental Protection Agency, accessed December 18, 2021, https://www.epa.gov/chemical-data-reporting/legislative-and-regulatory-authority-chemical-data-reporting.
[47] Ibid.
[48] "Instructions for Reporting 2020 TSCA Chemical Data Reporting," Environmental Protection Agency (Office of Pollution Prevention and Toxics, November 2020), https://19january2021snapshot.epa.gov/sites/static/files/2020-12/documents/instructions_for_reporting_2020_tsca_cdr_2020-11-25.pdf.

A. Tier II Data Analysis

For clarification, all subsequent analysis refers to the Massachusetts' Tier II dataset of 2017, as provided by TURI. After filtering the 17,291 submitted forms by the category of 'main substance or mixture chemical' by inclusion of phenol or phenolic compounds such as NP or NPE, I produced a final dataset of 63 reports; supposedly representing all reported phenol quantities above the aforementioned thresholds in the state of Massachusetts in 2017. The 63 substance listings were divided between 28 different firms, with the procedural decision to group firms of the snaem name but different locations together due to their assumed similar management and operations. Figure 1 represents the percent of submitted reports associated with each labeled firm whereas Figure 2 conveys the distribution regarding the number of reports submitted by each facility. By displaying the same dataset differently, we can see that the distribution of reports by each facility reflects a positively skewed distribution. Further analyzing this distribution, a one-sample two-tailed t test was conducted where the average number of reports by facility for the greater population of all Tier II reports, calculated as 2.7359, was compared against our distribution for phenolic compound reports by facility. At a significance level of .05, we found a p-value of .2938 which indicates that the distribution for phenolic reports by facility is not significantly different from the number of reports by facility for the overall population of Tier II data.

Next, I looked at the distribution of phenolic compound reports by the Tier II category of 'Main Substance' to develop a further understanding of what products or materials were being reported. As conveyed by Figures 3 and 4, in which I generalized each specific main substance into its applicable usage category, it is apparent that a majority of these substances are associated with resin production and curing. It is worth noting that these categories were produced by my independent analysis and expanded research of the applicable Tier II data entries and thus it may be subject to some inaccuracies. Our analysis was most limited by entries that were too specific to be accurately extrapolated from and entries that were too vague to be condensed down from. Regardless, of the 63 reported main substances, 18 or 28.6% of them were directly associated with the curing or production of phenolic resins with 11 or 17.5% reported substances related to the curing or production of epoxy resins. In summation, resin production directly accounts for 46.1% of all phenolic compound reports in Massachusetts. As for other major industries, we had 10 counts or 15.9% of phenolic compounds as industrial cleaners, 9 counts or 14.3% of phenolic compounds as lubricants, and 7 or 11.1% of phenolic compounds as coating material. The remaining 12.8% of phenolic compound main substance reports were divided between the creation of drill components, construction insulation, petroleum distillates, medical usage, and the textile industry. As depicted by Figure 5, further analysis of the 18 phenolic resin main substances reveals that 66.7% were in liquid form while 33.3% were in solid form. Contrastingly, 100% of the epoxy resin substances were in liquid form. Considering that not all data may have been included in this dataset and our lack of access to more recent information, this data provides a fairly comprehensive general depiction of the main phenolic substances in Massachusetts.

Subsequently, I looked to analyze the main chemical of each Tier II report. However, I was challenged by inconsistencies in data labelling. Due to the omission of CAS numbers and variations in the labelling of the ‘Main Chemical or Mixture Name’ for some entries, I was unable to utilize 8 of the 63 data entries. Subsequently, some data points were labelled inaccurately such as multiple entries reporting the same CAS number of 118821 despite titles varying between ‘Phenol’ and ‘Alkylated Phenol Inhibitor.’ However, according to the official database of CAS numbers, neither of these were correct. Thus, for Figure 6, I sought to exclusively utilize CAS number as the categorical variable for gauging the distribution of main chemicals. There are 15 unique main chemicals for the 55 analyzed values with 29.1% of these main chemicals were unaltered phenol rather than a phenolic compound. Similarly to the main substance analysis, this understanding provides us with an image of the general main chemical composition of Massachusetts.

From Massachusetts' 2017 Tier II dataset we were able to conclude that the number of reports from phenol facilities is not statistically different from the larger population, the combined phenolic and epoxy resin industry is responsible for 46.1% of all Tier II phenol reports, and that 29.1% of all listed main chemicals are phenol, rather than a phenolic compound. Additionally, my analysis may be subject to some inconsistencies as a product of variances in the submitted reports and chemical nomenclature but provides insight that was previously not composed.

B. CDR and Inconsistencies

As for the 2016 national CDR datasets, I was able to access the information for 'Manufacturing Information,' 'Consumer and Commercial Use,' and 'Industrial Processing and Use.' After filtering each sheet for facilities in Massachusetts and then for facilities reporting phenolic compounds, I produced a series of 12 entries that were consistent across the three datasets. These represented four entries for Monson Companies for E.W. Kaufmann with the parent company of Azelis Americas, seven entries for SABIC Innovative Plastics with the parent company of SABIC US Holdings LP, and one entry for the Polnox Corporation which is an independent firm. The largest finding from the CDR dataset, however, was what was omitted. For a firm to report under CDR guidance, they need to have handled more than 25,000 pounds of that substance in that reporting year meaning that all three of these firms had satisfied that condition. Despite their CDR reporting, all three firms failed to submit any reports regarding possession of phenolic compounds for the subsequent 2017 Tier II dataset. To reiterate, the specified Massachusetts' TPQ for required Tier II data is 500 pounds if the phenolic compound is powdered or 10,000 pounds if the phenolic compound is solid; substantially less than the CDR threshold. Acknowledging that the Tier II thresholds are less than CDR thresholds, it is also worth noting that none of the Tier II firms submitted for CDR reports in 2016.

To cross reference this possible inconsistency and see if it was a general failure to submit any Tier II forms, I referred back to the 2017 Tier II data. While none of these firms appeared in my initial set of phenolic compound facilities, I filtered the Tier II data instead by the address and name of each facility as listed on the CDR sest to see what Tier II reports had been filed. Monson Companies had filed 42 Tier II reports in 2017 between their two listed addresses on the 2016 CDR reports. However, none of these 42 Tier II reports make any note of the presence of phenolic compounds. As for SABIC Innovative Plastics, they similarly had filed 5 Tier II reports in 2017 yet none of them made reference to the presence of phenolic compounds. Lastly, Polnox Corporation filed 0 Tier II reports in 2017.

While there may be some exceptions to the compounds and quantities that need to be reported, it is apparent that there are some inconsistencies in the current structure of chemical reporting, especially for phenolic compounds.

V. SNURs for NPs and NPEs

In efforts to increase accountability in chemical reporting, especially for phenolic compounds, the EPA proposed a SNUR in September of 2014 to address NPs and NPEs.[49] This would require manufacturers to provide the EPA with at least a 90 days notice before either resuming or commencing any significant new use that crosses the factors established under Section 8(a) of TSCA.[50] The SNUR, if enacted, would impact 4 NPs and 11 NPEs effectively imposing restrictions on 15 previously unprioritized phenolic compounds, listed in Figure 7.[51] For 13 of these substances, any new uses that are presently not ongoing would have to face scrutiny for classification as a significant new use.[52] As for the other two substances, any application outside of functioning as an intermediate in production or serving as a curing agent would classify as a significant new use.[53] Ultimately, this SNUR, if enacted, would allow the EPA to assess the intended use of an NP or NPE substance before it becomes heavily utilized which would be a critical step in working to diminish their damage on aquatic environments.

While the SNUR was proposed in 2014, as of November 2019 the EPA does not have established plans to finalize its enactment.[54] An internet search for updates on its progress is dismal with less than five results in the last year on the EPA's official website. This lack of progress, unfortunately, can be partially attributed to private lobbying from potentially impacted

[49] "Significant New Use Rules: Certain Nonylphenols and Nonylphenol Ethoxylates," Regulations.gov (Environmental Protection Agency, October 1, 2014), https://downloads.regulations.gov/EPA-HQ-OPPT-2007-0490-0211/content.pdf.
[50] Ibid.
[51] Ibid.
[52] Ibid.
[53] Ibid.
[54] "TSCA NP/NPE Regulation Probably Delayed until Completion of Risk Evaluation," Chemical Watch, November 1, 2019, https://chemicalwatch.com/83963/tsca-npnpe-regulation-probably-delayed-until-completion-of-risk-evaluation.

parties in the automotive, aerospace, and chemical industries.[55] A bias towards these groups can be reaffirmed by the aforementioned CDR's list of chemical substances partially exempt from reporting which now include certain phenol use with petroleum, sulfur, sodium salts, and gasoline.[56] In response to investigative questions posed by a Chemical Watch enquiry, the EPA confirmed that they may still finalize the SNUR but that they are currently trying to determine the best course of action as they, along with invested stakeholders, are working to first address concerns regarding nomenclature.[57] While my analysis of the chemical datasets would affirm that a need to clarify nomenclature around NPs and NPEs would be beneficial, it seems to be posing a serious hindrance to the enactment of critical legislation. The lack of prioritization on this SNUR in 2021 is only made more readily apparent when accessing the official text of the proposed legislation online where the most recent comments or edits to the document are from 2015.[58]

Ultimately the chances of the quick implementation of this SNUR in the upcoming future appears to be dismal, primarily due to limitations within the organizational structure of the EPA and their established procedural timelines. The SNUR for NPs and NPEs was proposed along with a list of 90 others concerning substances in 2014 which denoted their hazard, exposure and persistence.[59] Prioritization within this list is critical as 50% of the substances addressed by TSCA examinations are required to come from it.[60] However, the NP and NPE SNUR has yet to be selected for examination which, under current EPA evaluation cycle timelines, means the

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[55] Ibid.

[56] "Instructions for Reporting 2020 TSCA Chemical Data Reporting," Environmental Protection Agency (Office of Pollution Prevention and Toxics, November 2020).

[57] TSCA NP/NPE Regulation Probably Delayed until Completion of Risk Evaluation," Chemical Watch, 2019.

[58] "Significant New Use Rules: Certain Nonylphenols and Nonylphenol Ethoxylates," Regulations.gov.

[59] TSCA NP/NPE Regulation Probably Delayed until Completion of Risk Evaluation," Chemical Watch, 2019.

[60] Ibid.

projected earliest its review would be concluded by is late 2025.[61] In the scenario that the EPA were to then reach the conclusion that there is unnecessary risk posed by significant new uses of their 15 listed NPs and NPEs, they would have another two years to finalize regulatory standards placing the earliest full implementation of an NP and NPE SNUR in late 2027.[62]

VI. Conclusion

Phenol and its associated phenolic compounds such as nonylphenol and nonylphenol ethoxylates are currently heavily utilized substances in the production of a multitude of goods and services. While the associated costs of this dependence are documented with detriments both to human health and the environment at large, our primary system for monitoring the problem is the submission of usage reports by involved firms. From the analysis of the 2017 Tier II and 2016 CDR datasets, it is apparent that this data system for monitoring the utilization of phenolic compounds, while largely beneficial, still raises concerns over apparent inconsistencies in data collection and submission. Thus, in the current state in which there is a noted absence of accountability in the monitoring and progress of imperative legislation, phenolic compounds, with their documented costs to health and the environment, will remain a problem at large for the immediate future.

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61 Ibid.

62 Ibid.

VII. Figures

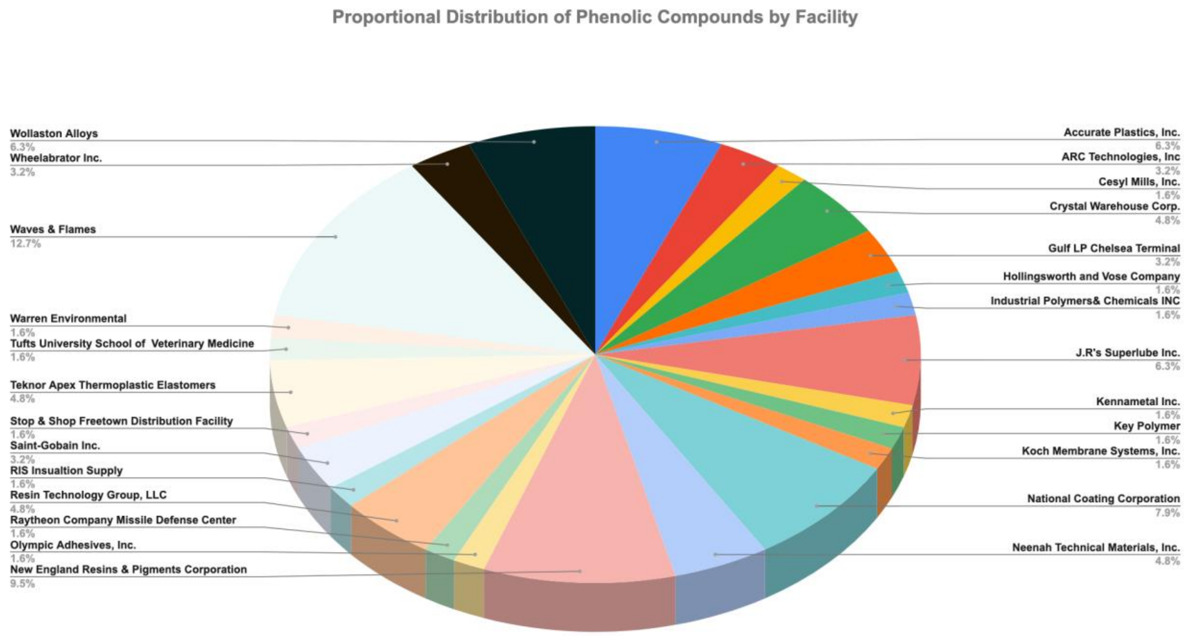

Figure 1. Composed of 2017 Tier II Data, this graph represents the percent distribution of the 63 phenolic compound reports between the 26 labelled reporting facilities. As a note, reporting firms with multiple locations were grouped together into a singular entity.

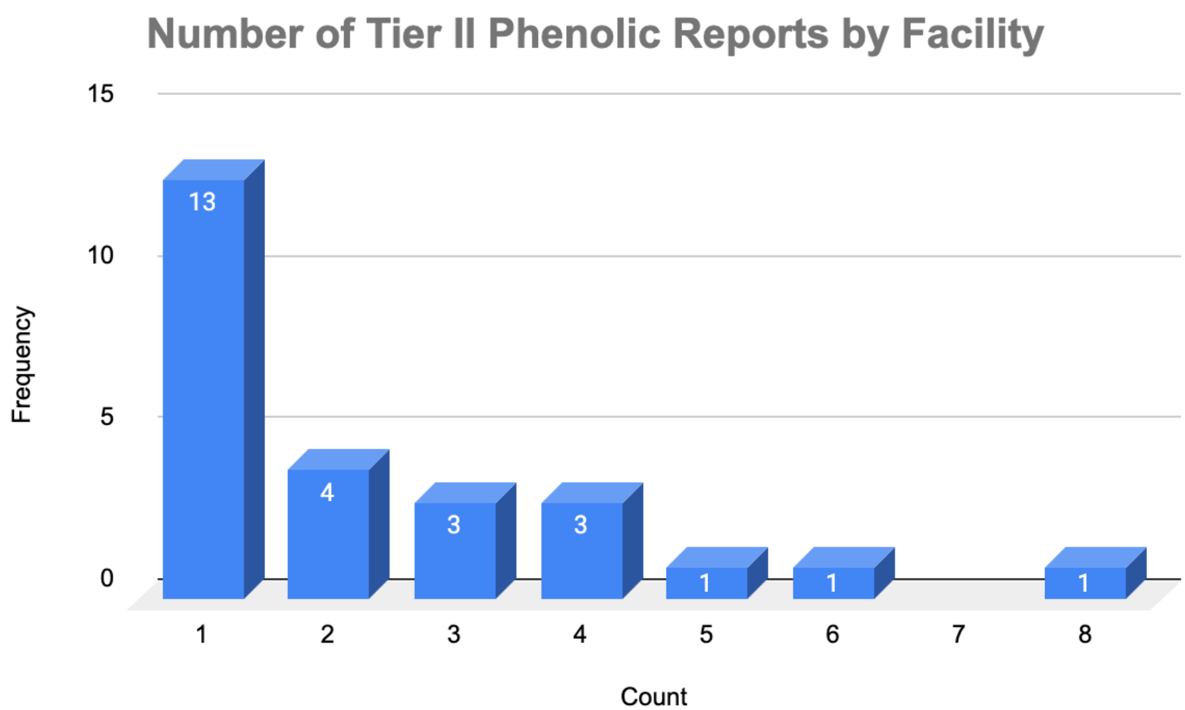

Figure 2. Composed of 2017 Tier II data, this graph represents the frequency of reports distributed between the 26 relevant facilities. As a note, reporting firms with multiple locations were grouped together into a singular entity.

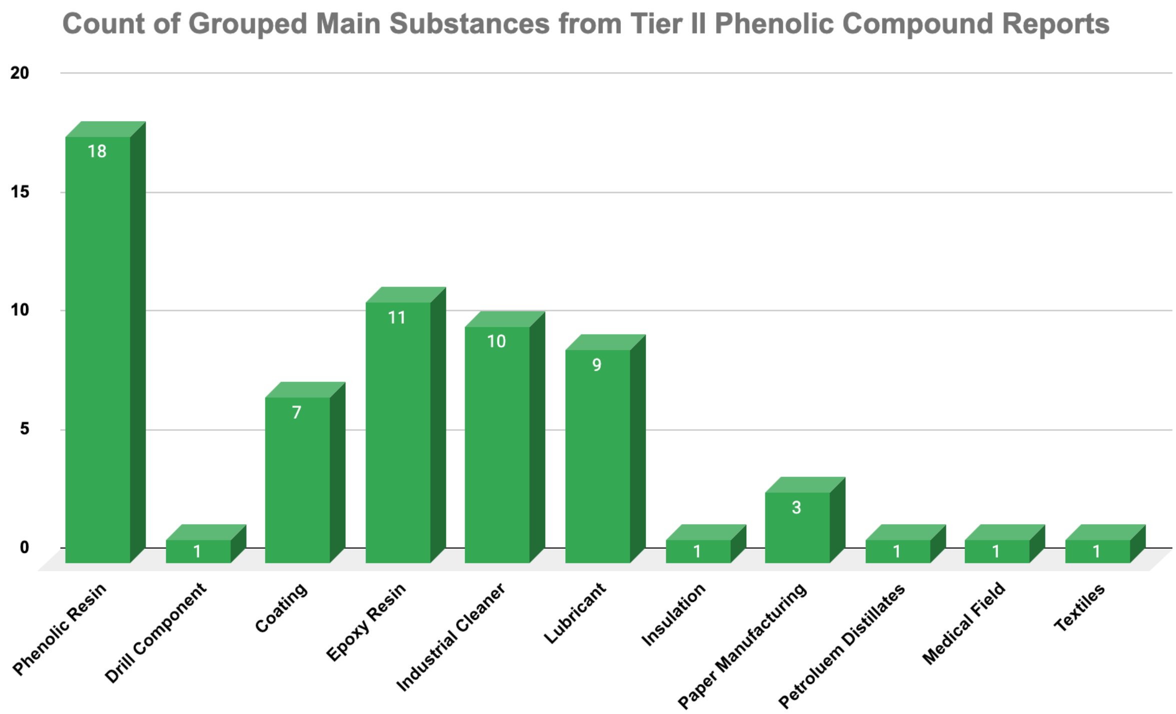

Figure 3. The count distribution of phenolic main substance materials according to the 2017 Tier II dataset.

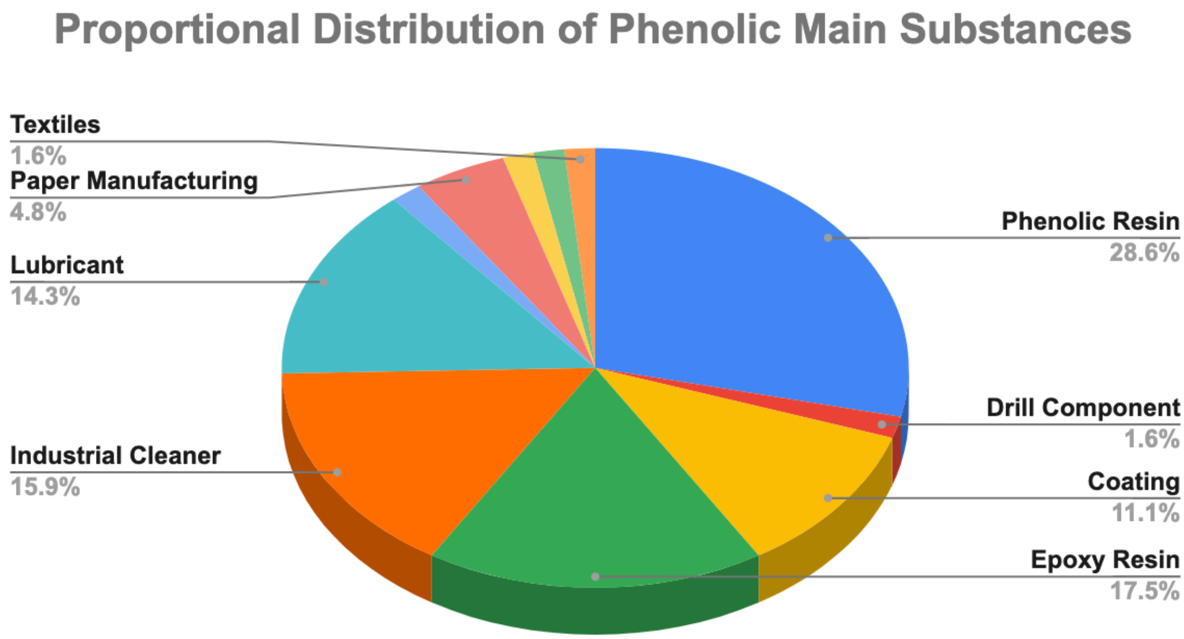

Figure 4. The proportional distribution of phenolic main substance materials according to the 2017 Tier II dataset.

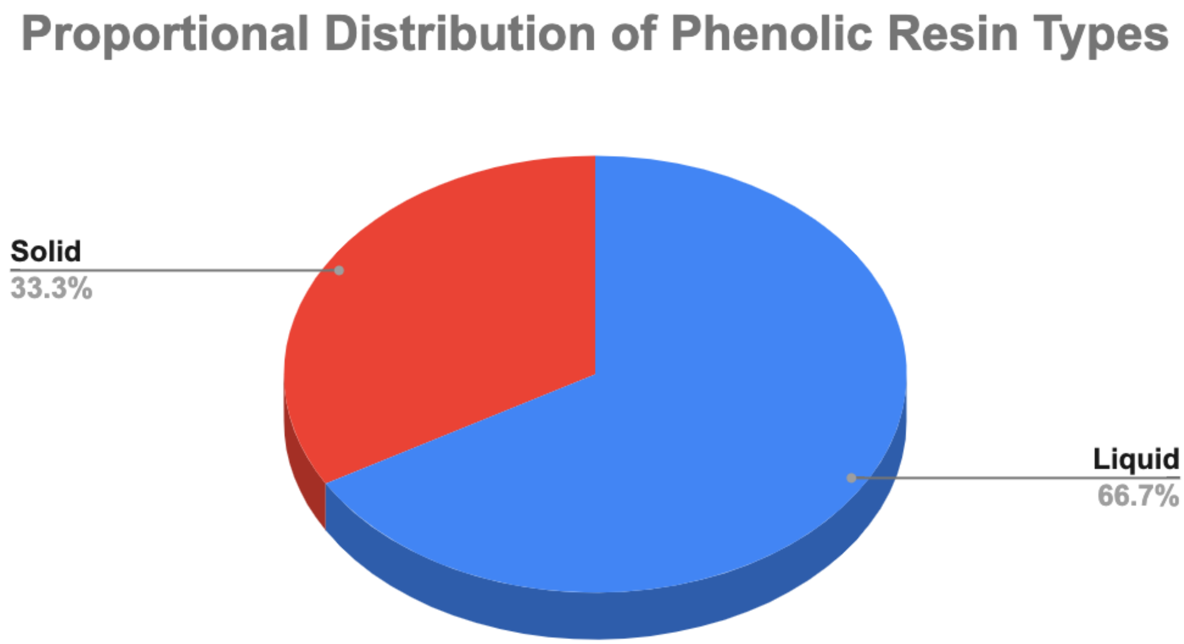

Figure 5. The proportional distribution of main substance phenolic resin from the 2017 Tier II dataset.

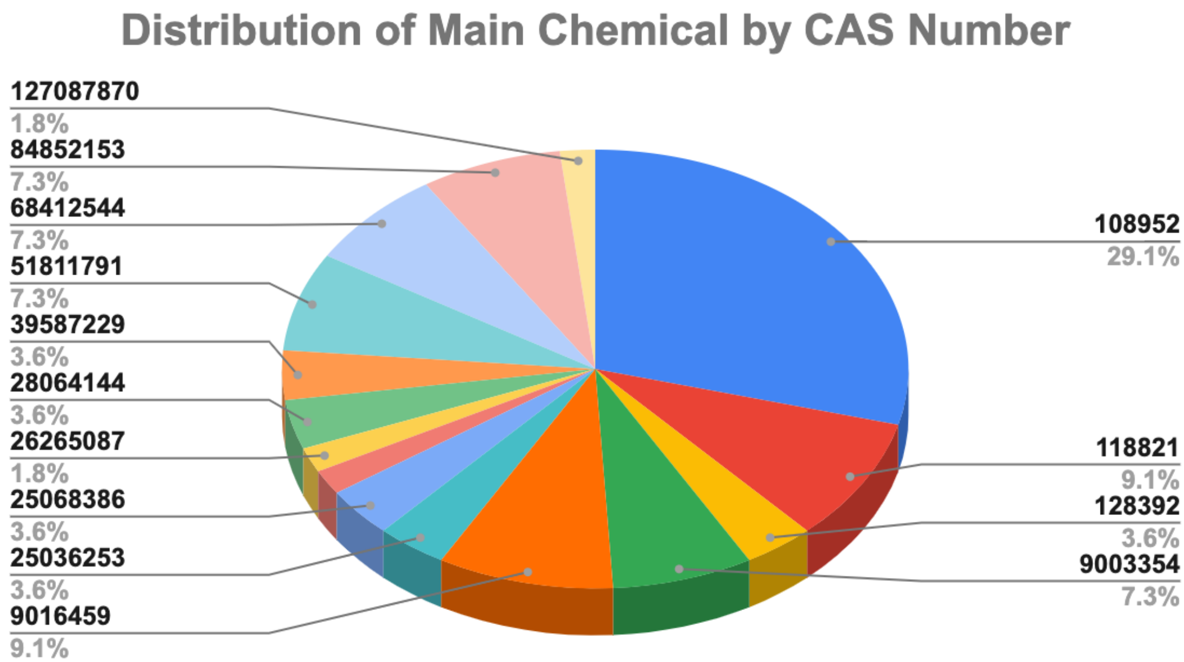

Figure 6. The proportional distribution of all 2017 Tier II reports by main chemical, with the omission of 8 values that did not input a CAS number.

Table 1—NPs and NPEs for Which Any Use Is a Significant New Use

Chemical name	Chemical abstracts index name	Chemical Abstracts Service Registry No. (CASRN)	NP or NPE
4-nonylphenol	Phenol, 4-nonyl-	104-40-5	NP
2-[2-[2-[2-(4-nonylphenoxy)ethoxy]ethoxy]ethoxy]ethanol	Ethanol, 2-[2-[2-[2-(4-nonylphenoxy)ethoxy]ethoxy]ethoxy]-	7311-27-5	NPE
α(Nonylphenyl)-ω-hydroxy-poly(oxy-1,2-ethanediyl)	Poly(oxy-1,2-ethanediyl), α(nonylphenyl)-ω-hydroxy-	9016-45-9	NPE
2-[2-(4-nonylphenoxy)ethoxy]ethanol	Ethanol, 2-[2-(4-nonylphenoxy)ethoxy]-	20427-84-3	NPE
Nonylphenol	Phenol, nonyl-	25154-52-3	NP
α-(4-Nonylphenyl)-ω-hydroxy-poly(oxy-1,2-ethanediyl)	Poly(oxy-1,2-ethanediyl), α-(4-nonylphenyl)-ω-hydroxy-	26027-38-3	NPE
2-[2-[2-[2-[2-[2-[2-[2-(Nonylphenoxy)ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethanol	3,6,9,12,15,18,21,24-Octaoxahexacosan-1-ol, 26-(nonylphenoxy)-	26571-11-9	NPE
2-[2-(Nonylphenoxy)ethoxy]ethanol	Ethanol, 2-[2-(nonylphenoxy)ethoxy]-	27176-93-8	NPE
2-[2-[2-[2-[2-[2-[2-(nonylphenoxy)ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethanol	3,6,9,12,15,18,21-Heptaoxatricosan-1-ol, 23-(nonylphenoxy)-	27177-05-5	NPE
2-[2-[2-[2-[2-[2-[2-[2-[2-(nonylphenoxy)ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethanol	3,6,9,12,15,18,21,24,27-Nonaoxanonacosan-1-ol, 29-(nonylphenoxy)-	27177-08-8	NPE
2-(Nonylphenoxy)ethanol	Ethanol, 2-(nonylphenoxy)-	27986-36-3	NPE
α-(Isononylphenyl)-ω-hydroxy-poly(oxy-1,2-ethanediyl)	Poly(oxy-1,2-ethanediyl), α-(isononylphenyl)-ω-hydroxy-	37205-87-1	NPE
α-(2-Nonylphenyl)-ω-hydroxy-poly(oxy-1,2-ethanediyl),	Poly(oxy-1,2-ethanediyl), α-(2-nonylphenyl)-ω-hydroxy-	51938-25-1	NPE

Table 2—NPs for Which Any Use Other Than as an Intermediate or Epoxy Cure Catalyst Is a Significant New Use

Chemical name	Chemical abstracts index name	Chemical Abstracts Service Registry No. (CASRN)	NP or NPE
4-nonylphenol, branched	Phenol, 4-nonyl-, branched	84852-15-3	NP
2-nonylphenol, branched	Phenol, 2-nonyl-, branched	91672-41-2	NP

Figure 7. A table from the EPA's 2014 proposed SNUR regarding NPs and NPEs which depicts the names of the 15 targeted substances.[63]

[63] "Significant New Use Rules: Certain Nonylphenols and Nonylphenol Ethoxylates," Regulations.gov.

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