

Alaska Community Action on Toxics

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**Comments on Proposed Operations Plan for the Soil Treatment
Technologies, LLC Thermal Treatment Facility, Nikiski, Alaska**
July 2, 2022

These comments are submitted by Alaska Community Action on Toxics (ACAT), a statewide non-profit public interest environmental health and justice research and advocacy organization dedicated to protecting public health. We are submitting comments on the Operations Plan (June 8, 2022) for the proposed Soil Treatment Technologies, LLC thermal treatment facility (“STT facility”), 52520 Kenai Spur Highway in Nikiski, Alaska. ACAT has members and their families who live, work, attend school, and recreate in the immediate area that would be affected. Members who live in the immediate vicinity have contacted us to express their concerns and opposition to the proposed facility.

In this set of comments, we re-state much of what we included in our comments on the prior draft operations plan (August 4, 2021) because our concerns have not been addressed in the new operations plan. We have supplemented the previous set of comments with additional substantive concerns and issues. The “new” operations plan proposes to increase soil capacity and re-configure the facility’s lay out and water management strategy, however, it fails to address substantive issues and concerns that have been raised by the community and in our prior comments. The operations plan does not describe the proximity to the residential area and school in the immediate vicinity nor the health hazards presented by the toxic air emissions to public health. In granting a permit for this facility and approving the operations plan, ADEC has failed in their responsibility to address public comments and concerns, demonstrated a bias favoring the applicant (STT) and a conflict of interest, and exhibited a lack of transparency. This public comment period is a sham because it is clear that ADEC intends to continue ignoring the very real threats to environmental and public health posed by the facility and approval is virtually pre-determined. It is also clear that STT and ADEC do not represent the best interests of the community and public health. We have no level of trust in STT to operate this facility in a safe manner nor in ADEC to provide proper oversight and regulation.

We note again that the majority of the 50+ comments on the proposed permit

were in opposition to the STT facility and based on legitimate concerns of people in the community about adverse effects that this facility will have on air and water quality, public health, property values, businesses and the local economy, wetlands, and wildlife. Over two hundred local residents signed a petition in opposition to the facility. ADEC failed to conduct a meaningful public review process and issued the "Minor Permit" without regard or due consideration of the public health, safety, and property rights issues raised in the public comments. People raised concerns about the lack of public notice, lack of adequate time for review, that the process was biased toward the applicant rather than the interests of the community and public health, and that many people were at unfair disadvantage in the process because they do not have computers or internet access. By issuing the permit, ADEC failed to meet the obligation to its mission of: *"Conserving, improving, and protecting Alaska's natural resources and environment to enhance the health, safety, and economic and social well-being of Alaskans."* It is within the Department's authority and pursuant to its obligations under the Constitution of the State of Alaska, the Public Trust Doctrine, and statutes and regulations to heed the public health threat posed by this proposed facility and to protect the rights and common welfare of present and future generations of Alaskans by revoking the permit and rejecting this Operations Plan. ADEC has not allowed sufficient time or meaningful public participation in the review of the permit or proposed operations plans. ADEC has ignored the public's legitimate concerns. ADEC claims "to ensure procedures were in place to protect human health, the environment, and Alaska's natural resources." This is a false assurance, as this facility presents a very real threat to environmental and public health.

The permit states that air pollution is prohibited and that "no person may permit any emission which is injurious to human health or welfare, animal or plant life, or property, or which would unreasonably interfere with the enjoyment of life or property." Yet, the facility is permitted to release annually up to 18 tons of NO_x, 12 tons of CO, 27.9 tons of SO₂, 5.9 tons of PM₁₀, 2.5 tons of PM_{2.5}, and 27.4 tons of VOCs. Refer to Table 1 for a summary of health effects associated with these air pollutants. These emissions present a serious public health hazard to the community of Nikiski and in particular to the people downwind and living within ½ mile of the proposed facility and to the children, teachers, and workers attending school at the middle and high school.

A recent study published in the American Journal of Public Health stated: "Air pollution exposure has been linked with preterm birth and low birth weight, known risk factors for many neurodevelopmental disorders in children. A growing body of human studies associate exposure to combustion-related air pollutants (PM_{2.5}, polycyclic aromatic hydrocarbons, nitrogen dioxide, black

carbon) with adverse effects on brain development, including deficits in intelligence, memory, and behavior. Polycyclic aromatic hydrocarbons, a component of PM_{2.5}, have been associated with developmental delay; reduced IQ; symptoms of anxiety, depression, and inattention; ADHD; and reduced size of brain regions important for processing information and impulse control.<https://ajph.aphapublications.org/doi/full/10.2105/AJPH.2018.304902> Other studies have linked roadway proximity, traffic-related PM, elemental carbon, or nitrogen dioxide to decreased cognitive function, including deficits in memory and attention. The effect of polycyclic aromatic hydrocarbon exposures during fetal development on cognitive and behavioral outcomes is magnified by material hardship or maternal demoralization. Low-income communities are thus disproportionately exposed and uniquely vulnerable because of family and community economic hardship. Increasing evidence links prenatal exposure to combustion-related air pollutants and PM_{2.5} to autism spectrum disorder.”¹ Emerging research, including a study from Harvard T.H. Chan School of Public Health,² finds that breathing more polluted air over many years may itself worsen the effects of COVID-19.

In addition to the health hazards presented by toxic air emissions from this facility that are not addressed in the permit or operations plans, the “new” operations plan fails to provide adequate evidence that noise pollution will be properly monitored and prevented. The American Public Health Association identifies noise pollution as a hazard to public health, stating: “Chronic noise, even at low levels, can cause annoyance, sleep disruption, and stress that contribute to cardiovascular disease, cerebrovascular disease, metabolic disturbances, exacerbation of psychological disorders, and premature mortality. Noise interferes with cognition and learning, contributes to behavior problems, and reduces achievement and productivity.”³

¹ Devon C. Payne-Sturges, Melanie A. Marty, Frederica Perera, Mark D. Miller, Maureen Swanson, Kristie Ellickson, Deborah A. Cory-Slechta, Beate Ritz, John Balmes, Laura Anderko, Evelyn O. Talbott, Robert Gould, and Irva Hertz-Picciotto, 2019: Healthy Air, Healthy Brains: Advancing Air Pollution Policy to Protect Children’s Health, *American Journal of Public Health* **109**, 550-554, <https://doi.org/10.2105/AJPH.2018.304902>.

² <https://doi.org/10.1126/sciadv.abd4049>

³ <https://apha.org/Policies-and-Advocacy/Public-Health-Policy-Statements/Policy-Database/2022/01/07/Noise-as-a-Public-Health-Hazard>

ACAT Table 1. Summary of Adverse Health Impacts for Major Harmful Air Pollutants

Pollutant	Health Impacts
Nitrogen Oxides	NO ₂ specifically: lower logical memory ¹ , more severe allergic responses, reduced pulmonary function, asthma, lower birth weight, and increased risk of preterm birth ² , increased risk of stroke ⁴ , deteriorates spatial learning and potentiates amyloid production ⁷ , contributes to an increased incidence of chronic cough ²⁰
Sulfur Dioxides	Respiratory irritant ²⁰ , increased risk of stroke ⁴ , induces inflammation of membranes, causes bronchial narrowing, and slows mucus flow ²³
PM ₁₀	Contributes to more severe allergic responses, increased risk of preterm birth, increased risk of pneumonia, and reduced lung function ²
PM _{2.5}	Penetrates deep in to the respiratory tract wherein it can be absorbed in to the blood stream ²¹ , can be translocated to organ tissue through blood circulation, contributes to more severe allergic responses, decreased birth weight, and asthma ² , lower verbal learning performance ¹ , increased cardiovascular mortality ^{4,5} , reduced cardiovascular function ^{5,22} , has the ability to enter the olfactory epithelium and can be transported to the olfactory bulb causing olfactory dysfunction ¹⁹ , induces inflammatory reactions across organ systems ²²
Formaldehyde	Eye, nose, and throat irritant resulting in cough, wheezing, chest pains, and bronchitis; a carcinogen resulting in increased incidence of lung and nasopharyngeal cancer ^{5, 26}
Toluene	Physiological depression of the central nervous system ^{16,17} , cardiotoxic ¹⁷ , causes renal tubular acidosis and can cause headache, dizziness, confusion, muscle weakness, and even muscle paralysis ¹⁷
Xylenes	Nose and throat irritation, severe lung congestion, pulmonary hemorrhages, edema, impaired short-term memory, as well as alteration in equilibrium or body balance ⁸ , reduced muscle power, depression of the central nervous system inducing symptoms such as headache, dizziness, and vomiting ⁹ , pathological changes in ovarian tissue, ovary atrophy ¹⁰
Acetaldehyde	Carcinogenic and genotoxic ^{11, 27} , can cause mild respiratory irritation ²⁷
Ethyl Benzene	Ototoxic (having a toxic effect on the ear or its nerve supply) ^{24, 25}
Benzene	Reduced pulmonary function ² , decreases the number of cells in bone marrow causing blood disorders ^{2,5} , genotoxic causing genetic damage including DNA cross linking and sister chromatid exchanges ^{3,18} , increases cardiovascular risk and injury ⁶ , shortness of breath and lethargy ¹⁷ , carcinogenic ¹⁸
Phenol	Accelerates pubertal development and disrupts estrogenic activity ^{12, 13}
Hexane	Inhibits follicular development, damages ovarian cell ultrastructure, and can cause menstrual abnormalities ¹⁴ , gestational inhalation can alter the reproductive cycle of female offspring ¹⁵

The Alaska Department of Environmental Conservation (ADEC) issued a “minor” permit (AQ1657MSS01) that would allow a waste treatment company, Soil Treatment Technologies, LLC (STT) to burn waste and generate toxic pollution

within yards of people's homes. ADEC's contravenes the Resource Conservation and Recovery Act (RCRA) and the Clean Air Act (CAA) and denies Alaskans vital health and environmental protection these statutes were enacted to provide.

There can be no question that the purpose of STT's "soil treatment unit" is to burn waste, specifically petroleum and solvent wastes that have been dumped or spilled in soil. According to the scanty information provided in ADEC's permit, the unit will cook contaminated soil in a rotary drum and then burn the organic chemicals that process yields in a thermal oxidizer. ADEC has made no effort to identify – let alone specify – the contaminated soils that can be burned in this unit. Nor has ADEC made any effort to identify the hazardous air pollutants that will be emitted from this unit, let alone provide assurance that they will not harm the health of the people who are forced to breathe this unit's pollution.

Of particular concern is ADEC's disregard of its own expectation that the unit will be treating soil contaminated with "chlorinated compounds." Heating and then burning chlorinated compounds will create dioxins, polycyclic organic matter, and other complex and persistent hazardous air pollutants. Even assuming that the thermal oxidizer will destroy 99 percent of volatile organic compounds, it will not destroy these organic chemicals. Moreover, because pollutants such as dioxins and furans are persistent, bioaccumulative, and extremely toxic even in tiny quantities, allowing the unit to create and emit even miniscule amounts of these pollutants will create long-term contamination of nearby neighborhoods and put the residents of these neighborhoods at risk of cancer and other serious adverse health effects.

A. ADEC's Reliance on a One-Line Narrative Prohibition on Treating Hazardous Waste Contravenes RCRA and Defeats Its Preventative Purpose.

It is well established that Congress enacted RCRA to be a preventative statute – a law that would prevent the harms that arise from treating hazardous wastes rather than just seeking to mitigate these harms after they occur. Discarded chlorinated solvents are hazardous wastes. The permit contemplates that STT will burn just that, soil into which "chlorinated compounds" have been dumped. Despite this, ADEC assumes that a single line in the permit will suffice to prevent precluding STT from burning hazardous waste. It will not. ADEC needs to establish testing and reporting requirements to ensure that STT does not burn hazardous waste. Otherwise, it is putting STT's neighbors at risk.

Nor does it suffice for the permit to say that "During a phone conversation

on April 7, 2021, the Permittee indicated that soils contaminated with chlorinated compounds may be treated on a case-by-case basis following approval by the Department's Division of Spill Prevention and Response, Contaminated Sites Program (CSP)." STT's vague "indicat[ion]" that CSP will review and approve the treatment of chlorinated solvents falls far short of ensuring that STT does not burn hazardous wastes. First, a statement of what STT has "indicated" is not a requirement of any kind. Second, neither CSP nor ADEC nor the people living near STT have any way of knowing whether STT will actually alert CSP and seek approval before it treats waste contaminated with chlorinated compounds, let alone whether those wastes are actually hazardous wastes for which a RCRA permit would be required. Third, the permit does not say what criteria CSP would apply in deciding to allow STT to treat wastes contaminated with chlorinated compounds, and provides no reason to expect that CSP's decisions will be adequately protective of public health and the environment.

B. Even if It Does Not Treat Hazardous Waste, STT's Facility Is an Industrial Waste Incinerator That Must Comply With Clean Air Act Incinerator Standards.

Assuming *arguendo* that SST will not be burning hazardous waste, it will be burning solid waste and is therefore subject to the Clean Air Act's requirements for solid waste incineration units.

ADEC states that the contaminated soil will first be cooked at 700 degrees Fahrenheit in a "rotary dryer drum." The stated purpose of the rotary dryer drum, however, is not to dry the contaminated soil but to "volatilize" the volatile organic compounds contaminating it. The same high temperatures that volatilize these compounds will also, necessarily, combust some of them. Because there at least some combustion will occur in it, the so-called "dryer drum" is in fact a combust unit. And because the soil being combusted in that unit, it is a solid waste incineration unit within the meaning of Clean Air Act § 129(g), 42 U.S.C. § 7429(g). Section 129(g) provides "[t]he term "[solid waste incineration unit](#)" means a distinct operating unit of any facility which combusts any [solid waste](#) material from commercial or industrial establishments or the general public (including single and multiple residences, hotels, and motels)." *Id.* It is well established that the term "any" means "any."

Even if solid waste combustion will not occur in the "rotary drum dryer," it will occur in the thermal oxidizer. ADEC states the exhaust gases from the "dryer" – which by ADEC's admission could include chlorinated organic compounds – will be burned in a "thermal oxidizer." Gases contained within STT's thermal oxidizer

are “contained” gases that come from the waste that STT puts in the dryer. They are, therefore, solid waste within the meaning of RCRA and the Clean Air Act. The Clean Air Act provides that “solid waste” has the meaning established by EPA pursuant to RCRA, 42 U.S.C. § 7429(g)(6), and RCRA provides expressly that “[t]he term “solid waste” means any garbage, refuse, sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility and other discarded material, including solid, liquid, semisolid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations, and from community activities,” 42 U.S.C. § 6903(27). Because it burns these contained gases, STT’s unit is a solid waste incineration unit.

Lastly, even if the dryer and thermal oxidizer could be viewed as something other than incinerators individually, they must be viewed together as a “distinct operating unit” of STT’s facility. Viewed together, they are a solid waste incineration unit that must meet the requirements of Clean Air Act § 129.

Because the Clean Air Act’s incinerator requirements apply unambiguously to all solid waste incineration units of any kind, STT must obtain a Clean Air Act Title V permit and meet all the requirements of EPA’s Clean Air Act for industrial incinerators. STT cannot avoid these requirements by obtaining a “minor” permit. Section 129 applies to all incinerators, regardless of their size. Indeed, Congress’ decision not to provide a size cutoff for the incinerator requirements in § 129 reflects its understanding that the pollution from all incinerators is especially dangerous even in small quantities and needs to be controlled, monitored, and reported to the public.

The “new” Operations Plans falsely claims that it is protective of human health and the environment. This is a dishonest claim and one that is not supported by the evidence, especially given that this facility is in such close proximity to a residential neighborhood, school, and businesses.

There are major deficiencies in the Operations Plan, including:

- Failure to prevent excessive releases of hazardous air pollutants in close proximity to a residential area, school, and recreational trails. There are homes, wells, a school, a seafood processing plant and other small businesses, and recreational paths in the near vicinity of the proposed facility. This is unacceptable. These hazardous air pollutants threaten human health.
- Failure to adequately demonstrate that it can prevent contamination of drinking water sources, including public and private wells in the area. The

operations plan must include a hydrological analysis. The operations plan does not provide sufficient evidence of protection of the aquifer and drinking water sources. There is a strong potential for groundwater contamination. The operations plan does not provide sufficient evidence that discharged water will remain on site. Annual groundwater monitoring is insufficient and off-site monitoring should also be required. The hydrology of the area is poorly described and not supported by scientific evidence.

- Failure to adequately demonstrate how it will protect wetlands, surface waters, and wildlife, including aquatic life, bald eagles, sandhill cranes, moose, and other species.
- Failure to adequately demonstrate how it will protect the workers of the plant, such as placement of eyewash stations etc., evacuation plans, training schedules, preventative maintenance plans to ensure the machinery is working properly and prevention of other hazards to occupational health.
- The operations plan does not specify how it is determined that the material has had an adequate retention time in the dryer.
- The operations plan does not define for what “beneficial reuse” the oversized material and treated soils will be used.
- The operations plan does not provide a sufficient explanation for the safe disposal of the concentrated, contaminated dust and particles from the filter bags.
- The post-treatment soil sampling described in the operations plan is inadequate and not scientifically defensible.
- The operations plan states that “clean gases are exhausted to the atmosphere at approximately 800 degrees F.” What are these “clean” gases?
- The operations plan claims emissions destruction of 99%, however this is not substantiated and is not credible.
- The operations plan states that: “For the first 30 days of plant operation, STT personnel will traverse the property boundary with a volatiles analyzer for measuring volatile organic concentrations and a decibel meter to measure the noise from operations.” It is not acceptable to allow the operator to conduct such a haphazard monitoring of VOCs and noise. This is not technically or scientifically defensible. ADEC should at least require a well-defined monitoring plan that includes sufficient placement of stationary monitors for particulates (PM 2.5 and PM10), VOCs, and noise that provide data to the public in real time.
- The operations plan states that: “If volatile concentration readings are detected, STT will take corrective measures. The appropriate corrective action for excessive decibel levels will be determined upon discovery of the source of the noise.” The “appropriate” corrective measures for addressing volatile pollutants and noise are completely vague and up to the discretion

of the operator. We liken this to the “fox watching the hen house.” This is unacceptable and not protective of the health of the community.

- The operations plan fails to address the likelihood of higher emissions and incomplete combustion during start up and shut down.
- The operations plan includes a proposal for increased storage capacity of four thousand tons of contaminated soil and 400 of “clean” soil, indicating a total of 5,200. This does not add up. We are unconvinced, based on the poor safety record exhibited by the operator and inadequate plans for containment in the “new” operating plan, that contaminated soils can be safely stored on site. The proposed methods of storage and cover are not adequate to prevent releases from the facility.
- The recent cave-in of the roof at the facility exposed stored contaminated soil to wind and water erosion, yet neither the operator nor ADEC have provided information to the public about how this failure was handled. What was the fate of the contaminated waste? Was the exposed material disposed? Was there spillage?
- It is not acceptable to merely inspect water collected in the catch basin before discharging it onto the post-treated pile. The water should be sampled to ensure it meets appropriate water quality standards.
- The operations plan states that: “Treated water will be discharged onto the ground surface at least one hundred feet away from any known drinking water wells or surface water bodies. Discharged treated water will be released in such a manner that it will infiltrate into the ground, will not create erosion or runoff, and will remain within the property boundaries.” This is not sufficient to protect the integrity of drinking water sources and there is no evidence or substantiation that the treated water will remain on site.
- The operations plan does not specify a schedule of how often ADEC will request emissions source testing and who conducts the source testing.
- Soils contaminated with chlorinated hydrocarbons should never be burned in a facility such as this (for reasons stated above). The operations plan states that STT will not accept any characteristic or listed RCRA hazardous waste, yet it is proposed that the facility might accept soils contaminated with chlorinated solvents and even attempts to define limits of emissions for hydrochloric acid (HCL) to no greater than 9.9 tons in any consecutive 12-month period. This is a blatant attempt to circumvent obligations under the Clean Air Act. HCL is toxic and corrosive (inhalation, ingestion, or contact with skin, eyes) with vapors, dusts or substance may cause severe injury, burns, or death. Thermal decomposition can lead to release of irritating gases and vapors.
- The number of samples per cubic yard is totally inadequate to properly characterize the post-treatment excavated soil.

- The operations plan fails to address and identify measures to prevent safety hazards such as fires and explosions or what to do if there is one (e.g. originating in baghouse or other parts of the facility).
- STT could remediate hazardous materials outside of DEC's knowledge. The operators do not have a demonstrated record of safe operations or compliance. There is a lack of public trust in STT as reflected in public comments on the proposed permit.

Based on the threat to public and environmental health, the permit (AQ1657MSS01) should be revoked, and the proposed "new" operations plan rejected. This facility should not be allowed to operate in this residential community. Safe non-combustion alternatives should be required for the destruction of contaminated soils.

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CC EPA Region 10 Office of Air and Radiation, and RCRA Program

References Cited

1. Gatto N, Henderson VW, Hodis HN, et al. Components of air pollution and cognitive function in middle-aged and older adults in Los Angeles. *NeuroToxicology*. 2014; 40: 1-7.
2. Kim D, Chen Z, Zhou L, Huang S. Air pollutants and early origins of respiratory diseases. *Chronic Dis Transl Med*. 2018; 4(2): 75-94.
3. Duarte-Davidson R, Courage C, Rushton L, Levy L. Benzene in the environment: an assessment of the potential risks to the health of the population. *Occup Environ Med*. 2001; 58(1): 2-13.
4. Bourdrel T, Bind MA, Bejot Y, Morel O, Argacha JF. Cardiovascular effects of air pollution. *Arch Cardiovasc Dis*. 2017; 110(11): 634-642.
5. Suh HH, Bahadori T, Vallarino J, Spengler JD. Criteria air pollutants and toxic air pollutants. *Environ Health Perspect*. 2000; 108(4): 625-633.
6. Abplanalp W, DeJarnett N, Riggs DW, et al. Benzene exposure is associated with cardiovascular risk. *PLoS One*. 2017; 12(9).
7. Yan W, Yun Y, Ku T, Li G, Sang N. NO₂ inhalation promotes Alzheimer's disease-like progression: cyclooxygenase-2-derived prostaglandin E₂ modulation and monoacylglycerol lipase inhibition-targeted medication. *Sci Rep*.

2016; 6: 22429.

8. Reese E, Kimbrough R. Acute toxicity of gasoline and some additives. *Environ Health Perspect.* 1993; 101(6): 115-131.

9. Kandyala R, Raghavendra SPC, Rajasekharan ST. Xylene: an overview of its health hazards and preventive measures. *J Oral Maxillofac Pathol.* 2010; 14(1): 1-5.

10. Niaz K, Bahadar H, Maqbool F, Abdollahi M. A review of environmental and occupational exposure to xylene and its health concerns. *EXCLI J.* 2015; 14:1167-1186.

11. Moeller BC, Recio L, Green A, et al. Biomarkers of exposure and effect in human lymphoblastoid TK6 cells following [¹³C₂]- acetaldehyde exposure. *Toxicol Sci.* 2013; 133(1): 1-12.

12. Wolff MS, Teitelbaum SL, Pinney SM, et al. Investigation of relationships between urinary biomarkers of phytoestrogens, phthalates, and phenols and pubertal stages in girls. *Environ Health Perspect.* 2010; 118(7): 1039-1046.

13. Rasier G, Toppari J, Parent AS, Bourguignon JP. Female sexual maturation and reproduction after prepubertal exposure to estrogens and endocrine disrupting chemicals: a review of rodent and human data. *Mol Cell Endocrinol.* 2006; 254-255: 187-201.

14. Jin L, Ling HH, Fen P, Chang ZW. The effect of n-hexane on the gonadotoxicity of female mice. *Biomed Environ Sci.* 2012; 25(2):189-196.

15. Li H, Zhang C, Ni F, et al. Gestational n-hexane alters the expression of genes related to ovarian hormone production and DNA methylation states in adult female F1 rat offspring. *Toxicol Lett.* (239)3: 141-151.

16. Cohr KH. Toluene. A toxicological review. *Scand J Work Environ Health.* 1979; 5(2): 71-90.

17. Vitale CM, Gutovitz S. Aromatic (Benzene, Toluene) Toxicity. Treasure Island, FL: StatPearls Publishing. <https://www.ncbi-nlm-nih.gov/nunm.idm.oclc.org/books/NBK532257/>. Published October 27, 2018. Accessed January 23, 2019.

18. Arnold SM, Angerer J, Boogaard PJ, et al. The use of biomonitoring data in exposure and human health risk assessment: benzene case study. *Crit Rev Toxicol.* 2013; 43(2):119-153.

19. Ajmani GS, Suh HH, Pinto JM. Effects of ambient air pollution on olfaction: a review. *Environ Health Perspect.* 2016; 124(11): 1683-1693.

20. Groneberg-Kloft B, Kraus T, Mark A, Wagner U, Fischer A. Analysing the cause of chronic cough: relation to diesel exhaust, ozone, nitrogen dioxides, sulphur oxides, and other environmental factors. *J Occup Med Toxicol.* 2006; 1:6.

21. Traboulsi H, Guerrina N, Iu M, Maysinger D, Ariya P, Baglolle C. Inhaled pollutants: the molecular scene behind respiratory and systemic diseases

associated with ultrafine particulate matter. *Int J Mol Sci.* 2017; 18(2): 243.

22. Nemmar A, Holme JA, Rosas I, Schwarze PE, Alfaro-Moreno E. Recent advances in particulate matter and nanoparticle technology: a review of the in vivo and in vitro studies. *Biomed Res Int.* 2013; 2013: 279371.

23. Rall DP. Review of the health effects of sulfur oxides. *Environ Health Perspect.* 1974; 8: 97-121.

24 Cappaert NLM, Klis SFL, Muijser H, et al. Ototoxic effects of ethyl benzene in rats. *Hear Res.* 1999; 137: 91-102.

25. Vyskocil A, Leroux T, Truchon G, et al. Ethyl benzene should be considered ototoxic at occupationally relevant exposure concentrations. *Toxicol Ind Health.* 2008; 24(4): 241-246.

26. Conolly RB, Kimbell JS, Janszen D, et al. Human respiratory tract cancer risks of inhaled formaldehyde: dose-response predictions derived from biologically-motivated computational modeling of a combined rodent and human dataset. *Toxicol Sci.* 2004; 82(1): 279-296.

27. Sapkota M, Wyatt TA. Alcohol, aldehydes, adducts, and airways. *Biomolecules.* 2015; 5: 2987-3008.

28. National Research Council. *Cumulative Environmental Effects of Oil and Gas Activities on Alaska's North Slope.* Washington, DC: The National Academies Press; 2003. <https://doi.org/10.17226/10639>.