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Health Implications of PM2.5

What is PM2.5 and Why You Should Care

PM2.5 refers to atmospheric particulate matter (PM) that have a diameter of less than 2.5 micrometers, which is about 2% the diameter of a human hair. Since they are of such small size, fine particles tend to remain longer in the air than heavier particles. This increases the likelihood of humans and animals inhaling them into their bodies. Being of such small size, particles smaller than 2.5 micrometers are able to bypass the nose and throat and enter deep into the lungs, with some even entering the circulatory system.

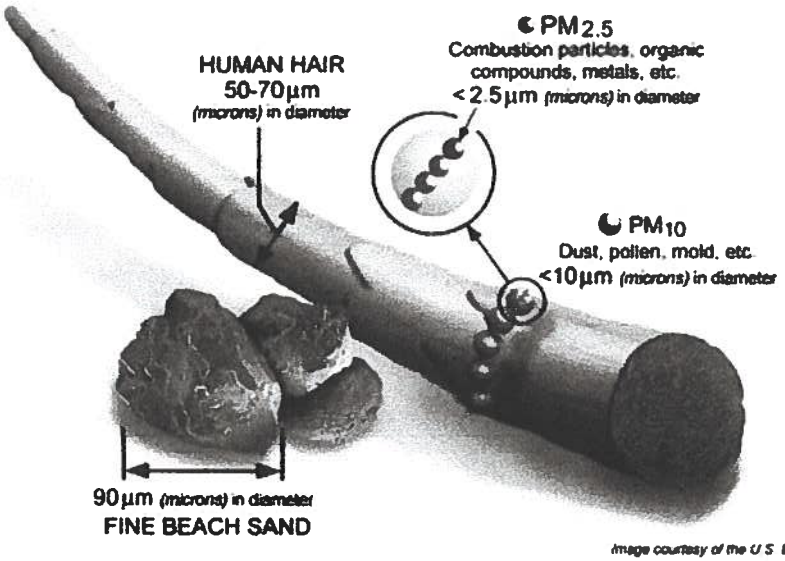

Image courtesy of the U.S. EPA

Where do they come from?

Fine particles can come from various sources. These include power plants, motor vehicles, diesel trucks,

airplanes, agricultural burning, ***concrete mixing (batching) facilities***, among others. The majority are dispersed directly into the atmosphere, often referred to as "fugitive" dust, while others are formed when gases and particles interact with one another in the atmosphere. Most commonly, this forms far more dangerous particles such as *Ozone and Sulfur Dioxide and Nitrogen Oxides, all of which are very harmful to animals and humans.*

What effects do PM2.5 particles have on the human body?

Research such as that conducted by Harvard School of Public Health has found a clear link between exposure to fine particles and premature death from heart and lung disease. Fine particles such as PM2.5 are also known to worsen chronic disease such as asthma, cardiovascular disease e.g. heart attacks, bronchitis and other respiratory problems such as COPD. This initial study was followed up in 2020 confirming the causal link between premature death and exposure to PM2.5 pollution. Indeed, even exposure to PM2.5 levels below that of EPA regulations showed causal relationships to premature death, particularly in those with chronic disease and/or the elderly.

A study published in the Journal of the American Medical Association collected data showing that long-term exposure to PM2.5 may result in vascular inflammation, leading to plaque formation which can eventually lead to heart attack and stroke. Analysis of the data established that for every 10 micrograms per cubic meter (µg/m3) increase in fine particulate air pollution, there is an associated 4%, 6% and 8% increased risk of all-cause, cardiopulmonary and lung cancer mortality, respectively.

In 2004, the first American Heart Association scientific statement on "Air Pollution and Cardiovascular Disease" concluded that exposure to particulate matter (PM2.5) air pollution contributes to cardiovascular morbidity and mortality. In the interim, numerous studies continued to add to our understanding of this causal relationship. A comprehensive review was then published in the the AHA journal Circulation in 2010. On the basis of the findings of this review, several new conclusions were reached, including the following:

> *"Exposure to PM <2.5 µm in diameter (PM2.5) over a few hours to weeks can trigger cardiovascular disease–related mortality and nonfatal events; longer-term exposure (eg, a few years) increases the risk for cardiovascular mortality to an even greater extent than exposures over a few days and reduces life expectancy within more highly exposed segments of the population by several months to a few years."*

What are the effects of PM2.5 on pregnancy, pediatric lung development?

An association between mothers' exposure to fine particles and adverse pregnancy outcomes has also been established by several studies. A comprehensive review of ambient air pollution and pregnancy

outcomes was conducted in the peer reviewed journal, *Environmental Research*. Within their discussion of findings it was determined that:

> *"Exposure to particulate matter and ozone over the entire pregnancy was significantly associated with higher risk for preterm birth"*

A comprehensive analysis of chronic 2.5PM exposure to school age children conducted by the Journal of Thoracic Disease concluded:

> "PM2.5 exposure, when estimated as exposure dose averaged over a year or longer, was associated with statistically significant reductions in FVC and FEV1 in children of elementary-school age."
> *FVC and FEV1 are measurements of lung function and capacity.

Asthma continues to be one of the leading causes of childhood morbidity and mortality for children in America.

The American Journal of Respiratory and Critical Medicine constructed a time-stratified case-crossover data set among 1,627,002 hospitalizations during 2000–2012 and estimated risk of asthma hospitalization associated with short-term PM2.5, O3, and NO2 exposures.: They concluded with:

> "Low-level PM2.5 and NO2 exposures were associated with higher risk.... Short-term air pollutant exposures increased risk of asthma hospitalization....***even at concentrations well below national standards. "***

Researchers from Johns Hopkins University found that children exposed to outdoor coarse particulate matter (PM10-2.5), were more likely to develop asthma and need emergency room or hospital treatment for it.

> "Exposure to higher average coarse PM levels is associated with increased asthma prevalence and morbidity. These results suggest the need for direct monitoring of coarse PM and reconsideration of limits on long-term average coarse PM pollution levels."

In summary, air pollution is the largest environmental risk to public health. There is simply no safe level of PM2.5 pollutants released from industrial applications such as cement batching plants, diesel powered vehicles and on-site diesel power plants that are required to run these facilities. The above referenced studies, all of which are from peer reviewed journals (with supporting studies cited) have found direct links to PM2.5 pollutants and to cardiovascular, pulmonary and neurological harm resulting in an overall increase in population morbidity and mortality. ***This is particularly the case for those facilities neighboring residential areas.***

The most harmful air pollutants spreading with prevailing winds into these residential areas are nitrogen

dioxide gas (NO_2) and fine particulate matter, PM2.5 – particles smaller than 1/30 the size of a human hair that can be inhaled deep into the lungs and easily enter into the circulatory system, leading to the harmful health effects cited. These harmful long-term effects are particularly ***impactful for children and those suffering from chronic respiratory and cardiovascular conditions.***

It is my professional opinion as a physician licensed to practice medicine in the state of Indiana that placement of the proposed cement mixing facility at 3103 W. 1000 North Fortville, IN 46040 would pose an ***immediate and sustained risk of harm*** to the adjacent residential neighborhoods.

Per Fortville Zoning Ordinance 10.20.21 application process The Board of Zoning Appeals must use seven (7) "Special Exception" decision criteria to determine whether to grant or deny the requested special exception for cement batching facilities. Within these criteria, number three (3) states:

"The special exception shall not involve ***any element or cause any condition that may be dangerous, injurious, or noxious to any other property or persons***, and shall comply with the development standards of Article 6 of the Fortville Zoning Ordinance."

Based on the above referenced studies and geographic location proposed, ***criteria #3 can not be met***.

Based on the aforementioned studies of medical fact the "Concerned Neighbors from the Town of Fortville and City of Fishers" herby insist the Fortville Zoning Board of Appeals ***deny*** petition No. 01-SE-2022 from Don Fisher of Insight Engineering (petitioner) for a Special Exception to place a cement batching facility at 3103 W. 1000 North Fortville, IN 46040.

Respectfully on behalf "Concerned Neighbors from the Town of Fortville and City of Fishers",

Christopher S. Nelson, M.D.

Concrete Batch Plant

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Guide to Air Quality Permitting for Concrete Batch Plants

First Edition, Fall 2018

The University of Texas at Austin
Environmental Clinic
School of Law

TEXAS ACCESS to JUSTICE FOUNDATION

A concrete batch plant site will generally be at least an acre, and much larger sites are not uncommon. The site will have stockpiles of sand and gravel, and there will be conveyor belts that move these materials into position to be mixed with the cement. There will also be a driveway, often, a circular one, for the concrete trucks, and there will be some internal material haul roads.

There may be a railroad spur that brings in the raw materials, i.e., the sand, gravel, cement, and cement supplements. There will be a small building or two on the site for such things as office space and the storage of repair parts and cleaning materials. Owners and operators of large concrete batch plants sometimes also operate other facilities, such as asphalt plants or rock crushers, at the same site.[2]

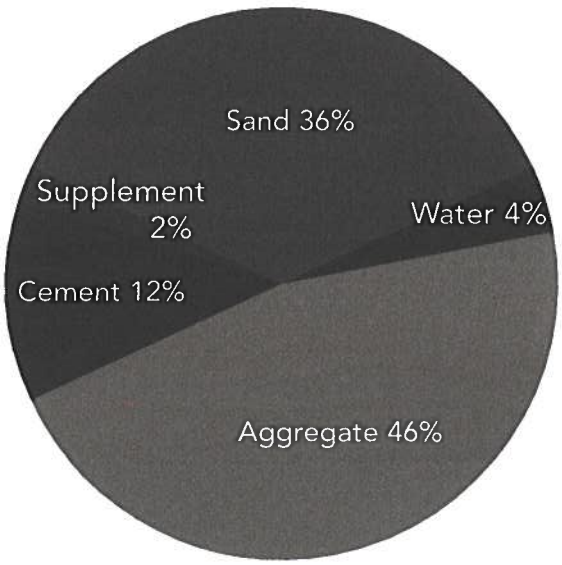
> Additives to the cement mixture may include materials such as fly ash, granulated blast-furnace slag, and silica fume, which are intended to make the concrete more economical, reduce permeability, or increase strength. They may also include chemical additives, which are usually liquid ingredients intended to entrain air, reduce the water required, retard or accelerate the setting rate, make the concrete more fluid, etc. The Texas Commission on Environmental Quality's (TCEQ's) standard permit prohibits the use of additives that release volatile organic compounds.

This is not an industry that has changed greatly in recent decades. The TCEQ's predecessor agency, the Texas Natural Resource Conservation Commission ("TNRCC"), determined in the late 1990s that most concrete batch plants produced between 100 and 300 yd^3/hr of concrete.[3] Various sources indicated to the agency staff that average production rates were in the lower half of that range, between 157 yd^3/hr to 176 yd^3/hr. Industry representatives participating in focus group meetings hosted by the agency indicated that a 200 yd^3/hr production rate was a reasonable worst-case assumption for most plants in Texas, with the exception of a central-mix style plant, which could approach 300 yd^3/hr. (Central-mix plants mix the cement and the water at the plant site in a fixed mixing machine; central-mix plants usually make large volumes of concrete for use very nearby.)

Batch plants are generally broken into two categories: permanent concrete batch plants and temporary concrete batch plants. TCEQ defines "temporary plants" as those that occupy a particular location for no more than 180 days or until a single construction project is completed. There are a few plants, usually permanent ones, that are treated as a third separate category. These are "specialty" concrete plants. Specialty concrete plants might make such things as precast concrete products, prefabricated building and road materials, cement blocks, concrete pipes, septic tanks, or statuary. The output of specialty plants is generally small, when compared to the output of permanent and temporary plants that mix concrete for off-site construction projects.

Composition of Concrete by Weight

A cubic yard of wet concrete weighs about 4,024 pounds



Source: EPA, AP-42, ch. 11.12, Table 11.12-2, note "a" (2011).

About Portland Cement

Portland cement is the binding ingredient in concrete. It was patented in England in 1824. The name suggested the strength of construction stone from the Isle of Portland.

Portland cement is a mixture of limestone, clay, iron ore, and small amounts of other minerals. These materials are ground into a slurry and heated to very high temperatures in a nearly horizontal rotary kiln, which might be very large (e.g., 12 feet in diameter and 500 feet long). The slurry is fed into the high end of the kiln. At the lower end is a roaring flame, perhaps 2700 degrees Fahrenheit. A number of gases are driven off by this firing process. The remaining material, called clinker, emerges at the low end as gray marble-sized balls. These are, themselves, ground to a fine dust with a small amount gypsum and limestone.

Hazardous wastes are often used as fuel for the flame, and the overall process can create a number of pollutants, including mercury and toxic acid gases. The exhaust dusts from cement kilns were defined by Congress in 1980, pending further study, not to be hazardous wastes. 42 U.S.C. §6921(b)(3)(A)(iii), the "Bevill Amendment." Over the last 40 years, however, there has been continuing controversy as to the risk that these toxic pollutants adhere to and within the clinker. See, for example, Kleppinger, "Cement Clinker: An Environmental Sink for Residues from Hazardous Waste Treatment in Cement Kilns," 13 Waste Management 553-572 (1993).

"Basic Information: Air Emissions from the Portland Cement Industry," EPA, www3.epa.gov/airquality/cement/basic.html, and "How Cement is Made," Portland Cement Association, www.cement.org.

WHAT PROBLEMS DO CONCRETE BATCH PLANTS CREATE FOR NEIGHBORS?

Air Pollution Issues:

Neighbors most commonly complain about dust and particulate matter (PM) emissions from concrete batch plants.

PM emissions come primarily from the transfer of cement and additive materials to the silos, the transfer of sand and aggregate, truck loading, mixer loading, and sand and aggregate blowing from the piles.[4] Roadways internal to the plant site are also big contributors to the overall level of dust associated with a plant. The PM is comprised mainly of cement and dust from the additives; there are metals associated with the PM.[5] The impact of dust on neighbors is usually controlled by the continuous watering, i.e., misting, of plant roadways and other sources of dust. Dust may also be somewhat controlled by establishing a buffer zone between roadways and neighbors. Another protective measure is to erect a barrier between the roadways and the neighbors.

> Based on observations and experience, the TNRCC found that the height of a dust plume will be about twice the height of the vehicle generating the road dust. To achieve approximately 50% control of the dust plume, the height of a barrier was thought to be at the height of the plume center line. Based on the modeling, the agency found this height to be about 12 feet.
>
> (TCEQ Regulatory Guidance RG-056, December 2000, p. 9 of 49)

Air pollutants - including carbon monoxide, nitrogen oxides, volatile organic compounds, particulate matter, nickel and formaldehyde - can also be generated by on-site internal combustion engines.[6] Most concrete batch plants that have engines use diesel compression ignition internal combustion engines up to 1,000 horsepower.[7]

Finally, while not part of the concrete plant itself, the trucks that access the facility are often diesel-fueled and frequently idle outside the facility waiting to load for long stretches of time. Emissions from

idling concrete haul trucks are not included in the TCEQ's potential to emit calculations for concrete batch plants.

Particulate emissions are a complex mixture of extremely small particles and liquid droplets. Once inhaled, these particles can affect the heart and lungs and cause serious health effects, including increased risk of heart attacks, aggravation of asthma, and decreases in lung function.[8] The smaller particles, 2.5 micrometers and less in diameter, are the most harmful ones, since they are inhaled more deeply in the lungs than are larger particles.

Both EPA and TCEQ have Potential to Emit Calculators for Concrete Batch Plants that can be used to help estimate a facility's emissions.

https://www.epa.gov/sites/...06/concrete_batch_plants_pte_calculator070214_0.xlsx and https://www.tceq.texas.gov/assets/public/permitting/air/Guidance/NewSourceReview/emiss-calc-cbp.xlsx.

TCEQ estimated that a 300 yd^3/hr plant that was limited to 6,000 yd^3/day and did not generate its own electricity (i.e., did not run a diesel generator) would emit an average of about 4 pounds of total particulate matter per hour during a 24-hour period. Please see the further explanation in the endnote[9] to understand that in any one hour that rate could be higher. If the plant does not generate its own power, TCEQ estimates about 0.24 pounds per hour (6% of total emissions) will be $PM_{2.5}$. If the plant does generate its own power, TCEQ assumes all the particulate emissions from the generator are $PM_{2.5}$. With on-site power production, $PM_{2.5}$ emissions rise to about 1.13 pounds/hour, 4.7 times as much as in the "no power generation" scenario.

Non-Air Pollutant Concerns:

TCEQ will likely state that the first two of these concerns are outside of its jurisdiction. They are, however, issues that can be addressed in a settlement.

Noise: Noise is sometimes a problem for concrete plant neighbors. Large concrete trucks, those with the roughly cone-shaped mixing barrels on their backs, often arrive before dawn to pick up loads of concrete to take to construction sites, and the idling of these early-morning arrivals and their reverse warning sounds can be noisy, in addition to spreading diesel fumes throughout the neighborhood.

Traffic: The traffic of the trucks, depending on the roadway layout near the plant, can be a problem for the neighborhood, particularly when the trucks travel through or idle near residential areas.

Polluted wastewater runoff: The site stockpiles and dusty roads can contribute sediment to rain that falls on them, causing muddy runoff to the nearby neighborhood, if the runoff is not well-controlled by the plant.

HOW ARE CONCRETE BATCH PLANTS REGULATED?

This guide addresses only air quality permitting in any detail. However, other permitting programs also affect the operation of a concrete batch plant and may provide avenues for the local citizens to lessen the impact of a plant.

Storm water and waste water

A concrete batch plant that discharges storm water associated with the plants' operation, rather than retaining the water on-site, will need a storm water permit. A permit is needed if the storm water has come in contact with the stockpiles, infrastructure, or equipment at the plant.[10] In addition, if the plant discharges conventional waste water, for example, water that was used to wash down trucks or clean equipment, it will likely need a separate waste water discharge permit from TCEQ. If a plant's discharges are to a storm sewer, the terms of the city's municipal separate storm sewer system, i.e., "MS4," permit may also regulate the discharges.

There is a TCEQ general storm water permit that covers storm water discharges associated with a concrete batch plant. (A "general permit" is like a "standard permit" but is an authorization under the Clean Water Act rather than under the Clean Air Act.) The current general permit for concrete batch plants is Attachment E to this guide. As you will see from the coverage limitations on pages 6 and 7 of the permit, the general permit may be unavailable for operations near the Edwards Aquifer recharge zone or if the discharges might affect an endangered or threatened species. There are several other instances where storm water discharges may not be covered by the general permit. In the event a concrete batch plant does not qualify for or does not want to commit to the terms of coverage as described in the general permit, an individual Texas Pollution Discharge Elimination System ("TPDES") permit will usually be needed. A Storm Water Pollution Prevention Plan ("SWPPP") is required in order to secure coverage under the general permit and, as a practical matter, under an individual NPDES permit. These plans are not automatically submitted to the TCEQ for review, so they are often prepared poorly or not at all. A plan that conforms to the agency's SWPPP regulations can greatly improve the facility's storm water practices, if it is enforced.

Land use regulation

In addition to other pollution permitting requirements, a concrete batch plant may be subject to local zoning or land use requirements. While temporary batch plants may have fewer restrictions, permanent batch plants located in a city will generally be limited to certain areas, unless the plant obtains some sort of special use exception or change in zoning. The city land use proceedings may provide the best opportunity for neighbors to actually stop the siting of a new concrete batch plant in their area.

HOW ARE AIR EMISSIONS AUTHORIZED?

Concrete batch plants cannot begin construction of air pollution emitting facilities until the air pollution emissions are authorized by the TCEQ. There are two permitting vehicles for authorizing air pollution from a concrete batch plant: an individual New Source Review (NSR) permit and a Standard Permit. With a New Source Review Permit, the permit terms are written for the specific facility seeking authorization. A Standard Permit is a generic permit that applies to a certain type of industry or operation. Any facility that meets the terms of the standard permit can claim coverage and operate pursuant to its limits. There are two versions of the standard permit.

Neither the individual NSR permit nor either of the standard permits for concrete batch plants supersedes other TCEQ regulatory requirements or requirements of the Texas or federal Clean Air Act.[11] Therefore, theoretically, the holder of an authorization to operate under the TCEQ standard permit may not do so in such a manner as to cause a nuisance. Nuisance operations are prohibited by TCEQ regulation.[12]

Individual NSR Permit

Any size concrete batch plant may decide to seek to authorize its emissions pursuant to an individual NSR permit, but it is the only avenue for large-capacity plants, i.e., plants with greater than 300 yd^3/hr production or 6000 yd^3/day production at one site. In 2012, TCEQ reported that an average of three to four concrete batch plants apply for a conventional NSR permit in any one year.[13] TCEQ data indicate that, at the end of 2017, 249 of 796 permitted concrete batch plants held individual permits.[14]

To obtain an individual NSR permit, Texas statutes require that the facility demonstrate: (1) it will use at least the best available control technology, considering the technical practicability and economic reasonableness of reducing or eliminating the emissions resulting from the facility; and (2) there are no indications the emissions from the facility will contravene the intent of the Texas Clean Air Act, including protection of the public's health and physical property.[15]

In addition, TCEQ's regulations require that an individual NSR permit application:

- Demonstrate protection of public health and welfare, including compliance with all TCEQ regulations and the intent of the Texas Clean Air Act, including protection of the health and property of the public;
- For any facility within 3,000 feet of an elementary, junior high/middle, or senior high school, consider any possible adverse short-term or long-term side effects that an air contaminant or nuisance odor from the facility may have on the individuals attending the school(s);
- Include provisions for measuring the emission of significant air contaminants as determined by the executive director;
- Assure the facility will achieve Best Available Control Technology levels of emissions control;
- Demonstrate compliance with any additional, applicable federal requirements, including: New Source Performance Standards, National Emission Standard for Hazardous Air Pollutants, Hazardous Air Pollutant requirements, Prevention of Significant Deterioration or Nonattainment New Source Review requirements;
- Show that the proposed facility will achieve the performance specified in the permit application;
- Comply with any air dispersion modeling requirements imposed by the TCEQ executive director; and
- Obtain allowances to operate if the facility is subject to a Mass Emissions Cap and Trade Program.[16]

The terms of the individual NSR permit may be crafted to address the particular needs of and risks posed by the plant. Many terms in an individual NSR permit for a plant will mirror those in permits for other plants, but there is no real standardization of terms.

Standard Permits

The second and most-used permitting vehicle is a "standard permit," of which there are two types: (1) the Standard Permit for Concrete Batch Plants and (2) the Air Quality Standard Permit for Concrete Batch Plants with Enhanced Controls.[17]

Standard Permit for Concrete Batch Plants: Texas Health and Safety Code § 382.05195, allows TCEQ to promulgate permits for categories of facilities and to apply the same air emission controls to all plants that are within the defined category. TCEQ can only issue standard permits for "the types of facilities will not make a significant contribution of air contaminants to the atmosphere" and may not authorize "major" facilities through standard permits.[18] There are few legislative requirements for these standard permits, only that the permits be enforceable, be ones the Commission can adequately monitor for compliance, and that the permits require the permitted facilities to use Best Available Control Technology ("BACT").[19]

TCEQ's predecessor agency issued its first standard permit for concrete batch plants in 2000. That permit, now a TCEQ permit, is occasionally amended, most recently in 2012. As of 2012, TCEQ estimated that the average rate of application for coverage under its standard permit was 94 plants/year.[20] The Standard Permit for Concrete Batch Plants covers three types of facilities: (1) permanent concrete batch plants, (2) temporary concrete batch plants, and (3) specialty concrete batch plants. The standard permit is available for any concrete batch plant located at a site producing less than 300 yd^3/hr. The permit has separate requirements for permanent and temporary and specialty plants.

"Temporary" plants are defined to be plants that occupy a particular location for not more than 180 days or until a single project was completed.