The California Asphalt Pavement Association

YOU SHOULD KNOW

Facts about asphalt plants, neighborhoods and the environment

Asphalt plants mix liquid asphalt binder (asphalt cement) with crushed rock, gravel, and sand to create the asphalt pavements you drive on or walk on every day. Asphalt cement is also called bitumen. Asphalt production is necessary to maintain the road systems throughout the United States and here in California. In fact, over 90 percent of all paved surfaces in the United States are surfaced with asphalt, and that figure is 95 percent in California. Locating asphalt production facilities in logistically strategic areas reduces distance that materials must travel from source to jobsite, lowering greenhouse gas emissions (GHG) associated with product transport and allowing rapid response to the needs of communities that are distant from urban or industrial areas. Proper and timely maintenance of roadways decreases infrastructure costs for these communities as well as promoting more efficient travel for all users of asphalt-paved roads. Finally, studies show well-maintained roads reduce costs to motorists by hundreds of dollars per year due to lost fuel economy and vehicle repairs.

Hot Mix Asphalt (HMA) and Warm Mix Asphalt (WMA) production

The Federal Highway Administration (1) describes Hot Mix Asphalt (HMA) as the traditional process for constructing asphalt pavements. It is manufactured in a central mixing facility by heating crushed rock and sand (aggregates) and asphalt binders above 300°F. It is kept hot during transport by truck, placement (where it is spread on the roadway by an asphalt paving machine), and compaction (where it is compacted by a series of asphalt roller machines to a finished surface that is strong, flexible and durable). The mixture cools after compaction to form the asphalt pavement. Warm Mix Asphalt (WMA) production uses the same process but temperatures generally start 10° to 50°F lower during mixing and remain lower during trucking, placement, and compaction. The lower temperature used in WMA manufacturing reduces emissions and odors. Depending on the production temperature, a range of 15-70 percent reduction of carbon dioxide and other emissions during production have been reported. Also, because production temperatures are lower, less fuel is needed to heat the asphalt. The reported reduction in fuel consumption typically ranges from 20-35 percent, with up to 50 percent reported for some technologies.

Asphalt product emissions

In California, the operation of asphalt plants are highly regulated by the California Air Resources Board (CARB), regional air districts, the State Water Quality Control Board (SWQCB), the California Department of Industrial Relations, Division of Occupational Safety and Health (Cal/OSHA), the California Department of Resources Recycling and Recovery (CalRecycle) and many other local, state and federal agencies. The U.S. Environmental Protection Agency (U.S. EPA) also regulates emissions from asphalt facilities and requires close monitoring of emissions to ensure that they meet air regulation requirements. In 2002,

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the U.S. EPA reviewed emissions from asphalt plants and determined that they were not a major source of air pollution. In 2004, the U.S. EPA measured HMA plant emissions by extensive air emission studies conducted at four sites and found them to be low (3). Asphalt plants employ multiple emission control systems as directed by regulations and may include monitoring to ensure that emissions of particulate matter, carbon monoxide, sulfur dioxide, nitrogen dioxide, and lead comply with the National Ambient Air Quality Standards (NAAQS) at the property boundary (4) . The small amount of emissions released from these control systems are closely monitored to ensure they stay well below any permitted level set by regulators to ensure that they pose no health or environmental risk to nearby communities (5) . Most visible emissions from an asphalt plant's stack are just steam resulting from the drying of aggregate (2, 5) . Low air emissions from HMA production have been confirmed by air monitoring data collected by state and federal agencies in communities near HMA plants. These data show air concentrations of HMA chemicals are typically below air criteria established by state authorities and for some chemicals, below background concentrations (6, 7) .

Health Hazard

Asphalt emissions have raised concerns in communities and these concerns have been investigated by state and federal agencies. When detailed health effects studies were undertaken around asphalt plants (specifically Hot Mix Asphalt facilities), no health effects from the plants were identified. In a six-year study performed in North Carolina in response to community concerns, both state and federal agencies concluded that there were no increased health hazards or risks associated with emissions from asphalt facilities as compared to areas without asphalt facilities (8, 9, 10) .

Other studies and state regulatory bodies have also found that asphalt plants, in general, do not pose an elevated health risk to surrounding communities (5, 11, 12) . Since air emissions from HMA facilities are low, it is not surprising that health effects have not been identified in communities around asphalt production facilities. In fact, the International Agency for Research on Carcinogens (IARC) lists asphalt (bitumen) paving exposures to workers as being in the same category of hazard as cell phone radio frequency electromagnetic fields or coffee (Class 2B) (13, 14) . Further, as described by the Colorado Department of Public Health & Environment (DPHE) (2), a typical asphalt facility does not generate hazardous waste and generates very little solid and universal waste. Some wastes (such as petroleum-contaminated soils or recycled asphalt) and waste from other industries (such as used tires) may be reused in the asphalt production process. In all cases, all wastes must be properly managed and disposed (2) . In California, that process is overseen by the California Department of Resources Recycling and Recovery (CalRecycle) and there are strict reporting requirements.

In California, an independent panel of scientists, the Carcinogen Identification Committee, part of the State of California, Office of Environmental Health Hazard Assessment, reviewed all relevant studies on asphalt and ultimately concluded in 2016 that asphalt was a "low priority" for further study, and therefore not eligible for inclusion in the state's official list of Proposition 65 substances known to cause cancer or birth defects (19) .

In the Information Age, so much information on health exposures is available, but not all of it in context and evaluated by experts in the field. According to a publication of the California Environmental

Protection Agency (CalEPA), “Health risk assessment requires both sound science and professional judgement and is a constantly developing process.” (21)

Exposures

Asphalt pavement is 95 percent small stones, sand, and gravel, and about 5 percent asphalt binder cement (“bitumen”). In addition, asphalt pavement may use recycled materials such as glass, recycled pavement, used tires or recycled plastic. As determined by the U.S. EPA (2002), emissions from asphalt plants have not been a major source of air pollution, and asphalt plants are regulated by state and federal authorities. In addition, emissions have been furthered reduced in recent years due to process improvements. Exposures to emissions at production facilities and paving sites have decreased up to 98 percent since 1970 (5) due to process improvements, lower temperature production, and use of natural gas in place of traditional petroleum products. In fact, the National Institute of Occupational Safety and Health (NIOSH) has recognized process change (warm mix asphalt) as a prime example of reducing or eliminating emissions (18) . In 2018, an update to a review of emissions from asphalt plants was published, providing comparisons of emissions from asphalt plants to other source of air pollutant emissions and typical background values (16) . The estimated emissions from an asphalt facility that produces 200,000 tons of asphalt per year were also compared to those generated by woodstoves and fireplaces, fast food restaurants, breweries, and gas filling stations. The results of the background comparison, below (TABLE 1), show that emissions from asphalt plants are below typical background concentrations (16) :

TABLE 1

Substance	Modeled emission for APM (µg/m3)	Background – outdoor air (µg/m3)	Background – Indoor air (µg/m3)
Particulate Matter 2.5 (a)	0.3	8	<8 – 29 (c)
Formaldehyde (a)	0.1	1.5	20
PAHs (b)	0.00009 – 0.0003	0.008 – 0.13	0.015 – 0.26
Benzene (b)	0.005 – 0.02	0.3 – 1.4	1.3 - 9.5

a) Estimate at 1000 feet from facility, includes stack and fugitive emissions
b) Range of values indicating typical or low end to high end in background samples or modeled values at 250 feet and 3000 feet from APM facility
c) Per Sanborn-Head 2018, the upper value is PM2.5 levels in indoor air of homes heated by residential wood stoves

Further, the study found that the typical emissions from an APM plant producing 200,000 tons of asphalt per year were equivalent to the following annual emissions:

- Total Volatile Organic Chemicals: 4 mid-size breweries, 20 residential fireplaces, or 5 gas refilling stations
- Benzene: 19 residential wood stoves or 1 gas refilling station
- PAHs: 21 Fast food restaurants or 180 residential wood stoves
- Formaldehyde: 7 Fast food restaurants or 150 residential fireplaces.

The estimates provided in the Sanborn report (2018) were based on the emissions from an HMA facility; the emissions from a WMA facility would be lower than an HMA facility, as production and holding temperatures are lower and emissions are therefore reduced.

In 2021, the City of Irvine, Calif., commissioned a study of the air quality near an asphalt plant "in response to concerns raised by nearby residents." The "multi-pronged emissions investigation" found "no elevated levels of air toxics detected" and "air toxic monitoring levels below long-term health-based threshholds." The study included air samples collected by the South Coast Air Quality Management District, which found the results "within background levels," and by the City of Irvine, which took samples from multiple locations for over 100 individual compounds and found that the "results show most concentrations are within typical regional background levels." (22)

Process Changes

As the asphalt industry strives to maintain a safe and healthy workplace for their employees and communities, process improvements have been implemented to decrease emissions and improve safety. The asphalt pavement industry has implemented technological advances to reduce an asphalt plant's environmental footprint. These advances have helped reduce the amount of energy needed to make asphalt pavements and have expanded the use of recycled materials in asphalt pavements, as well as lowering emissions (5) .

Lower Production Temperatures

Warm Mix Asphalt (WMA) is the general term for a variety of technologies that allow production of pavement material at lower temperatures. It has been proven to reduce fuel emission, fumes, and odors (17) . WMA production methods use temperatures 30 to 120 degrees Fahrenheit lower than traditional hotmix asphalt. Because less energy is needed to heat the asphalt mix, less fuel is needed to produce WMA. Fuel consumption during WMA manufacturing is typically reduced by 20 percent(17) . Emission from APM facilities are therefore reduced through use of less fuel and because lower temperatures means lower emissions from the asphalt itself.

Use of Natural Gas as APM Plant Fuel Source

Most emissions at asphalt mixing facilities come from the combustion of fuel, such as natural gas, that are used to dry and heat the rock or aggregate and keep the asphalt at the temperature needed for use and placement at paving sites (5) . As reported by the Colorado Department of Public Health and Environment, best management practices to minimize emissions during asphalt pavement material production have been established by the asphalt industry and include guidance on facility operation and maintenance to maximize efficiency and minimize emissions. Natural gas is a common fuel for asphalt plants, which is cleaner-burning than other types of fuel (2) .

Baghouse/Air Filter Improvements

Baghouses consist of several rows or compartments of fabric filters that collect the dust during the operation of an asphalt plant. They capture dust that may be released from the drying of aggregates (5) . Modern baghouse designs use more efficient media, improved cleaning, and structural enhancements to provide a more predictable, cost-effective, and energy-efficient filtration solution. Other technology used by asphalt plants to control emissions include counter-flow mixing equipment technology, enclosed or partially enclosed conveyor systems, and top-of-silo emission recovery systems (2) . Since 1970, stack emission has decreased 97 percent while asphalt production has increased 250 percent (5) because of improvements in emission controls.

Recycling

Asphalt is 100 percent recyclable, and is perhaps the most reused and recycled product in the United States and in California. In fact, the National Asphalt Pavement Association reports that asphalt binder recycled from old pavements and roofing shingles replaces more than 21 million barrels of oil per year, saving American taxpayers more than $2.2 billion annually. This also reduces emissions, both from asphalt production and the shipment of oil (5) . Hot and warm mix asphalt paving materials are a mixture of gravel and small stones (aggregate), sand, and asphalt binder, and may include recycled asphalt pavement (2, 5) . In addition to recycled asphalt pavement, other materials may be recycled into asphalt pavements including rubber from used tires, glass, recycled plastic and asphalt roofing shingles (5) . Asphalt pavement can be recycled repeatedly in new asphalt pavement mixes, and using reclaimed materials means less new material must be produced (5) . Standard specifications published by the California Department of Transportation (Caltrans) and many local agencies permit the use or RAP in pavement mixes.

Diverting used tires from California landfills is a goal of CalRecycle, and the use of rubber from scrap tires in asphalt is in widespread use in California. About 46 percent of asphalt used by Caltrans on freeways and highways includes Crumb Rubber Modifier (CRM), diverting the equivalent of 5.5 million tires a year (20).

Greenhouse Gas (GHG) emissions

In the most comprehensive industry inventory done to date, the National Asphalt Pavement Association (NAPA) in 2022 published a report titled, “GHG Emissions Inventory for Asphalt Mix Production in the United States (SIP 106),” as part of the broader “The Road Forward” net-zero carbon initiative. The report found that “cradle-to-gate” emissions associated with asphalt mix production in the United States represented approximately 0.03% of total U.S. greenhouse gas emissions in 2019. By comparison, U.S. EPA data indicate that transportation emissions from fossil fuel combustion represented 27.8% of total emissions in 2019, while industrial emissions represented 25.3%. (23)

Summary/Conclusion

Asphalt plant facilities play a vital role in the maintenance of our nation’s infrastructure and strive to be good neighbors in the communities they serve. The emissions from these facilities are even lower today as process improvements are now best management practices to reduce emissions and odors and increase the use of reclaimed materials. Compared to other pavement materials, asphalt pavement has a very small carbon footprint and has been recognized by the U.S. Department of Energy as a top material for sequestering carbon (5) .

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