

How Do Tobacco Smoke and Car Exhaust Compare?

Like petroleum combustion exhaust, cigarette smoke is a very complex chemical mixture that contains volatile, semi-volatile and non-volatile compounds, the latter associated with particles. Some 400-500 gaseous compounds and 3500 particulate phase compounds have been identified in cigarette smoke. Similarly, gasoline and diesel exhausts contain hundreds of gas phase compounds, although not all of the compounds present are identifiable. Despite many analytic studies, vehicle particulate matter has only been partially analyzed. Still, of the fraction analyzed, hundreds of organic compounds and many inorganic compounds have been identified in exhaust particles. More appear as the particles age in the atmosphere.

Many of the known toxic compounds in tobacco smoke are also emitted from combustion of petroleum hydrocarbons, so there is significant overlap in the lists of compounds that have been identified in these mixtures to date. The key difference is that tobacco, being a biological product, contains much more nitrogen than does crude or refined petroleum, in which nitrogen is rare. Thus, tobacco and tobacco smoke contain several classes of nitrogen-containing chemicals that are not present in petroleum fuels and their exhausts. Some of these are toxicologically important, associated with bladder cancer and other health effects. Thus, there is only a partial parallel in chemical composition, and some of the differences are sure to be important ones.

Following are two lists. In the first list, Table 1, are groups of toxins that are found in both tobacco smoke and petroleum vehicle exhaust. This list is not intended to be comprehensive, it is focused mostly on carcinogens and other important toxic substances. The second list identifies some classes of chemicals that are associated with tobacco smoke, but not exhaust. Again, important compounds from a toxicological point of view were selected.

The list in Table 2 isn't perfectly exclusive since a few of these compounds were identified by the International Agency for Research on Cancer as possibly present in diesel exhaust. However, the carcinogenic nitrosamines derived from nicotine are a very important difference.

There are also some groups of chemicals that are present in vehicle exhaust but not tobacco, such as hopanes and steranes, but little to nothing is known about them toxicologically.

Table 1 - Key Classes of Toxins Identified in Both Tobacco Smoke and Petroleum Vehicle Exhaust

Compound or Chemical Class	Health Effects of Concern
Alkanes (linear, branched or cyclic)	Many are relatively non-toxic, but hexane is neurotoxic
Aldehydes and other carbonyls (e.g. formaldehyde, acrolein, etc)	Respiratory irritation, cancer
Alkenes (e.g. 1,3 butadiene)	Cancer
Aromatic hydrocarbons (e.g. benzene)	Cancer, respiratory toxicity, reproductive toxicity, etc.
Polycyclic aromatic hydrocarbons	Mutagenic and carcinogenic, immune system toxicity
Inorganic gases (carbon monoxide, nitrogen dioxide)	Respiratory and cardiovascular toxicity
Heavy metals (some detected in both mixtures)	Cancer, neurotoxicity
Acids (mostly organic acids)	Respiratory irritation and damage

Table 2 - Key Classes of Toxins Found in Tobacco Smoke but not Petroleum Vehicle Exhaust

Compound or Class of Compound	Health Effects of Concern
Aza-arenes	Possible cancer
N-nitrosamines (many unique to tobacco smoke)	Cancer
N-heterocyclic amines	Cancer
Some metals (e.g. cadmium unlikely in petroleum fuels)	Cancer
Hydrazine	Cancer
Pesticides and breakdown products	Various
Proprietary flavor additives	Unknown