

ECOLOGICAL PROBLEMS OF TRANSPORT VEHICLES

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Summary: The article presents the influence of motor transport on the environment. The major ecological threats generated by road transport are mentioned and characterized. In addition, the environmental safety activities in the sphere of production, operation of vehicles, transport infrastructure and relating to recycling of end-of-life vehicles have been presented.

Key words: road transport, motorization ecology, emission of toxic compounds

INTRODUCTION

Road transport plays an important role in the shaping of economic development in each country. It binds together all the areas of economic and social conditions for co-operation between different spheres and sectors of the economy and the different areas of the country [Gilbert 1996, Rydzkowski, Wojewódzka-Król 2009]. Through the exchange of goods and cooperation between enterprises and regions of the country, it contributes to their balanced development. In addition, it allows for the activation of economic life in disadvantaged areas.

To maintain transport truck in the proper conditions, the technical background adequately equipped with specialist diagnostic apparatus is required [Chaciński, Jędrzejewski 1982]. Service and repairing activities within the technical supporting plants applied to road transportation means powered by combustion engines generate specific pollutions which have a negative impact on the environment.

Examining environmental problems occurring in the technical supporting system of the road transportation confirms that such issues are given too little attention. Environmental safety in the operational strategy of these plants is located at the end of the list of priorities. Instead, the prevailing concern is the economic effect meaning the receiving of maximum profits from the sale of services.

ECOLOGICAL THREATS GENERATED BY AUTOMOBILE TRANSPORTATION

The development of motor transport has had a major impact on the economic growth of many countries and contributes to a significant change in the way of life of their societies. By contrast,

the activity of technical supporting facilities and operation of motor transport means poses a major threat to the environment. Those risks involve [Zielińska, Lejda 2009]:

- atmospheric pollution with toxic components of vehicle exhaust,
- toxic effects of motor fuels during their storage, transport, distribution and use in motor vehicles,
- atmospheric pollution with products of tire and road surface wear and with dust arising from wear of friction linings and facings (clutches, brakes),
- contamination of the soil and water with agents used for cleaning and maintenance of car bodies,
- hazard caused by spills and leaks of fuels, oils and various working fluids,
- noise pollution and surface vibration caused by vehicle traffic,
- seizure of large areas of land for roads and parking plants,
- environmental pollution caused by disposal of well-worn vehicles and frequently replaced spare parts (gaskets, filters cartridges, tires),
- transport accidents,
- electromagnetic radiation.

Among these risks the air pollution coming from automobile exhaust is crucial [Wojciechowska, Wojciechowski 1990]. The exhaust gases, which come from combustion of various fuels such as diesel, gasoline or natural gas, contain many toxic compounds. The main components are carbon monoxide and carbon dioxide, nitrogen oxides, hydrocarbons (saturated, unsaturated, aromatic), sulfur dioxide, (small quantities), soot. These toxic substances emitted by cars are not only a source of very high risk to the environment, but they also contribute to the occurrence of many illnesses, including cancer and cardiovascular diseases, they can also be very harmful for kidneys and skeleton. They can cause severe poisoning, leading to a deterioration of mental ability, aggression, sleep disturbances, unconsciousness and even to death (Table 1).

Many substances, which are harmful both for the environment and living organisms' health, are produced and stirred by moving vehicles (e.g. dust). Apart from inert ingredients, they also contain harmful substances coming from the road, tires, linings and other vehicle components. Air, soil and water pollutions can also be caused by leakage and evaporation of fuels, oils and fluids. Their exuding from the vehicles and dispersion during their distribution contributes significantly to the environmental hazards.

The development of automotive industry also means an increase of the noise level, particularly in urban areas, and ground vibrations. Excessive noise and vibrations adversely influence all the living organisms. Ground vibrations can lead to the damage of buildings, steel structures and reinforced concrete. Noise is also an extremely dangerous phenomenon, and the consequences of its action are often perceived after a very long period of interaction, when most of them are already irreversible [Śmigieński 1992]. It badly affects health, even if its intensity is not high. Short-term staying under a high level of noise causes hearing fatigue with such symptoms as transient dulling or occasional hearing loss. Staying for a prolonged period of time under the influence of high level noise results in permanent hearing loss. In addition to audible noise, toxic effect on the human body is also shown by infrasound and ultrasound. Infrasound causes headaches, nausea, visual acuity, impaired sense of balance and general fatigue, while ultrasounds cause cardiovascular ailments, damage to internal organs and tissues. There have been known cases of death of people who have been subjected to acoustic vibrations caused by operation of jet engines. Noise, besides its impact on the human body, has also a significant impact on the quality and accuracy of work. Where the work requires a human to be focused and concentrated, a high noise level is an obstacle for its effective performance.

Table 1. The harmful effects of automobile exhaust toxic compounds on human body
[Zielińska 2008]

№	TYPE OF TOXIC COMPOUND	HEALTH EFFECTS	
1.	Carbon monoxide (CO)	low concentration	<ul style="list-style-type: none"> ▪ headache, dizziness, ▪ distortion of breathing
		average concentration	<ul style="list-style-type: none"> ▪ weakness, ▪ apathy, convulsions, shortness of breath
		high concentration	<ul style="list-style-type: none"> ▪ loss of consciousness, ▪ death
2.	Hydrocarbons (HC)	hydrocarbons, ethylene series	<ul style="list-style-type: none"> ▪ respiratory irritation, ▪ symptoms of narcotic use
		monocyclic aromatic hydrocarbons	<ul style="list-style-type: none"> ▪ nausea, dizziness, ▪ vomiting, ▪ loss of consciousness
		polynuclear aromatic hydrocarbons	<ul style="list-style-type: none"> ▪ damage to the cardiovascular system, ▪ damage to bone marrow, ▪ pro-carcinogenic action
		Hydrocarbons have a large share in formation of photochemical smog.	
3.	Nitrogen oxides (NO _x)	low concentration	<ul style="list-style-type: none"> ▪ eye irritation, ▪ respiratory irritation, ▪ general weakness, ▪ numbness of legs, ▪ mouth cyanosis
		high concentration	<ul style="list-style-type: none"> ▪ changes in the blood, ▪ pulmonary edema, ▪ damage to the central nervous system, ▪ myocardial degeneration
4.	Sulfur oxides (SO _x)	low concentration	<ul style="list-style-type: none"> ▪ eye irritation, ▪ irritation of the lower and upper respiratory tract, ▪ severe skin burns
		high concentration	<ul style="list-style-type: none"> ▪ acute bronchitis, ▪ dehydration of tissues, ▪ precipitation of proteins, ▪ corneal eye damage
		Sulfur oxides have a significant participation in acid rain and communication smog formation.	
5.	Particles (PM)	Because of the nature of formation and composition of particulates in Diesel engines, harmful effects in some ranges are similar to the action of hydrocarbons.	
6.	Lead (Pb)	<ul style="list-style-type: none"> ▪ accumulation in the body (kidney, liver, bones), ▪ severe lung disease 	

Another important ecological threat, both on the local and global scale, is the management of end-of-life vehicles. Formation of large quantities of waste – certainly a serious environmental problem – is amplified by a mass manufacture of automotive vehicles with mass use of materials and energy and wide use of vehicles. Vehicles withdrawn from the operation are also an economic problem, not only due to the costs of unused product waste, but also because of the storage costs, which grow at an accelerated rate.

New threats to the environment are the consequences of accidents during transportation of hazardous materials and substances. Transport accidents are a direct threat to human life and health, and an indirect threat to environment due to various pollutions (e.g. spills and evaporation of the substance transported from damaged vehicles, devastation of land, etc.). A harmful effect on the living organisms is also exerted by electromagnetic radiation of high intensity and long duration. Its sources are the electrical and electronic assemblies and electric drives of the vehicles and transport infrastructure.

All the above-mentioned threats prove the negative impact of transport on the environment. This impact depends on the diversification of means of transport and conditions for their use, as well as on comprehensive transport connections in all the areas of civilization, in particular involving the economy. The issues related to environmental impact in transport are primarily: motor vehicles and factories, consumption articles and supplies to/by manufacturers as well as transport infrastructure (Fig. 1). The recipients of transport impact are: people, animals, plants, air, water, soil, terrain and landscape (Fig. 2) [Zielińska 2008].

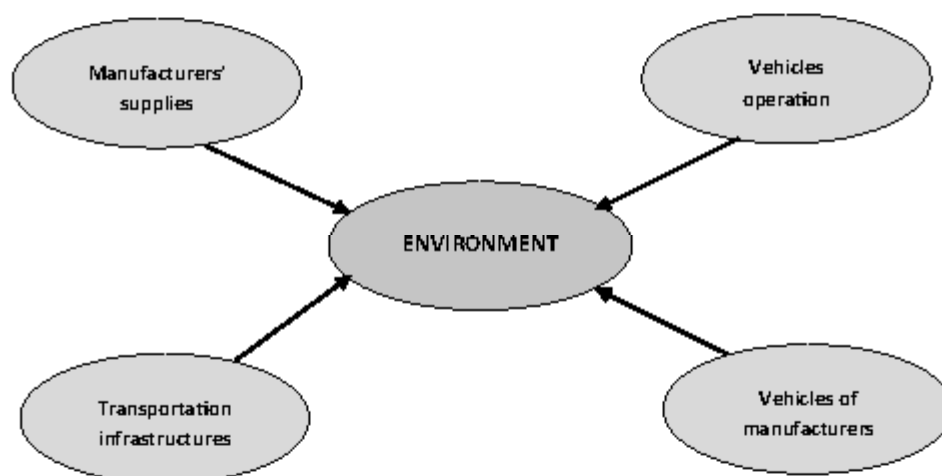


Fig. 1. Items of the environmental impact associated with transportation

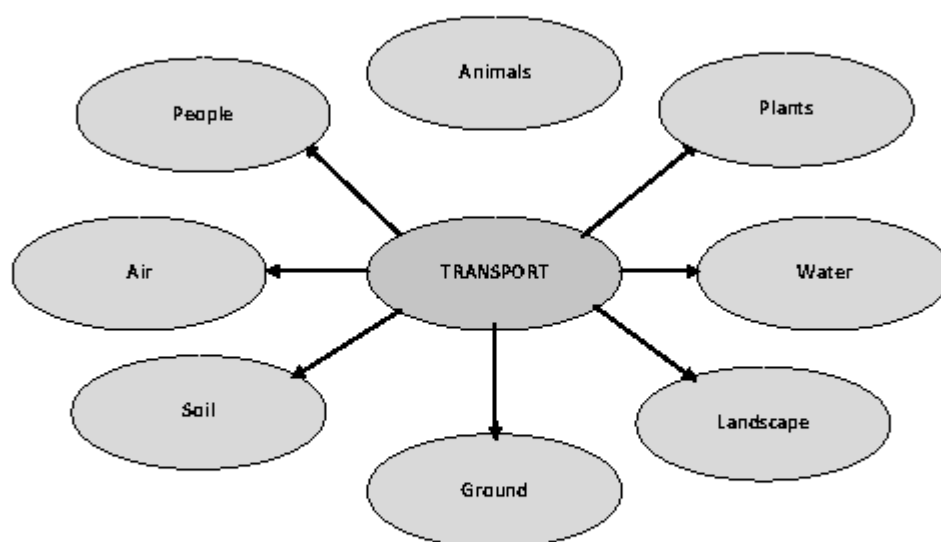


Fig. 2. The impact of transport on the environmental components

All transportation activities should be subordinated to the protection of the environment at all levels of the “vehicle existence” including the stage of design, manufacture, operation as well as the use and disposal of waste products as a result of the use and disposal of vehicles. Unfortunately, the negative impact of motor transport on the environment is not the only problem for vehicle manufacturers. The current socio-economic conditions create important problems to automotive companies, such as [Lejda 1995]:

- user satisfaction with the owned vehicle,
 - safe operation,
 - low cost of purchase and operation,
 - reliability and durability,
 - low fuel consumption,
 - low energy consumption at the manufacture and supply of materials.

Protecting the environment from the effects of the operation of motor transport gets a priority only in social terms.

ENVIRONMENTAL SAFETY MEASURES IN ROAD TRANSPORT

Due to environmental protection, the most important problems of motor transport are [Zielińska, Lejda 2008, Zielińska, Lejda 2009]:

- protecting the environment from the effects of production and operation of vehicles and transport infrastructure,
- reducing materials consumption, energy intensity and cost during the production and operation of vehicles,
- increasing the reliability and durability of vehicles,

- reducing materials consumption, energy intensity and cost during the recycling of used vehicles.

In ecological terms, the impact of these factors on the environment is not always immediately apparent. The relationships between them are very complex, and many subjects influence the environment directly or indirectly, with or without interactions. For markets dependent on road transportation, the greatest responsibility for the environment deterioration may be primarily put onto vehicles operation and management of waste materials from the use and disposal of used cars [Uzdowski, Abramek, Garczyński 2003]. The parameters like durability and reliability are also important because they reduce the amount of waste products during vehicles operation. Material and energy consumption during production and operation has also a measurable impact on the environment, as well as the waste vehicles management [Chłopek, Danilczyk, Gutowski, Kruczyński 1994]. The costs of these processes are wrongly neglected for pro-environmental activities, but it must be remembered that environment protection is very expensive, and the balance of finances in any social structure is subject to the same economic laws.

Solving environmental problems depends on the attitude of authorities and ordinary people as well. That is why the education on knowledge about the risks involved in the operation of automotive companies should become widespread so that every person can consciously decide whether he/she wishes to participate in the pollution of the environment or to protect it [Górka, Poskróbko, Radecki 1998, Janikowski 1998].

Activities in the sphere of production and operation of vehicles as well as transport infrastructure

A serious threat to the environment is undoubtedly the widespread use of cars equipped with hydraulic systems that require large quantities of various, often toxic, harmful and disruptive in operation liquids. In order to reduce negative impacts on the environment, new technologies are introduced, which make the production of cars much safer, more economical, efficient and environmentally friendly than before. Hydraulic systems are commonly replaced by high-quality electric and electronic systems that allow for the elimination of liquids and oils and, consequently, help to avoid the danger of spills. New cars are year-by-year easier to use, more fuel-efficient, comfortable and equipped with many amenities, such as electronic steering, electronic braking system, steering control and propulsion machinery, system for GPS navigation, etc.

Efforts in environmental protection mainly include improving air quality and fuel efficiency, minimizing emission, protecting natural resources in the production process. Research on alternative fuels that can power vehicles with lower exhaust emission and less pollution than petrol or diesel has been conducted for many years. For the sake of the environment, vehicles are equipped with complex systems for pollutant removal and new generation of on-board diagnostic systems (OBD), which informs not only of exceeding exhaust pollution level but also continuously analyzes the chemical composition of the exhaust and working fluids in order to signal the need for maintenance service.

Harmful impact on the environment due to the operation of vehicles comes from the fact that most of them are powered by a combustion engine. Reduction of this negative effect is possible by applying much more environmentally-friendly drives: electric, hybrid, or natural gas. Unfortunately, the use of such solutions involves the high cost of implementation.

An important environmental problem is the transportation infrastructure. The growing road traffic is associated with the necessity to build and maintain in good condition:

- transport and technical facilities, such as petrol stations, workshops, bus depots, etc.,
- roads, especially motorways and beltways, which receive an intensive transit traffic of vehicles and trucks.

The functioning of these components of motor transport infrastructure, especially roads, is not only a huge cost associated with their construction and maintenance, but also generates excessive noise harmful to the environment. Noise transmitted from the beltways and highways results from the huge traffic flow, poor technical shape of pavement and vehicles, poor traffic flow and lack of noise barriers. Road construction causes irreversible damage to the environment (landscape changes, disruption of plant and animals). A partial solution to this problem, already used by some highly developed countries, is to invest in rail transport, which is much cleaner, safer and cheaper than truck transport.

Activities related to management of end-of-life vehicles

In order to solve the environmental problem associated with the management of end-of-life vehicles, some specific projects are undertaken [Oprzędkiewicz, Stolarski 2003]. Their goal is to enable the reuse of materials and supplies obtained from dismantling the old or damaged vehicles. Reuse of materials from worn-out vehicles is involved in the concept of recycling. According to the type of products derived from recycled scrap cars, the recycling can be categorized into:

- recycling of products – the most cost-effective case, because combined with regeneration process, it allows to recover whole devices and spare parts for reuse,
- recycling of materials – it allows to obtain raw materials for production of new units or new components; (it may require special treatments i.e. melting the scrap iron and nonferrous metals, crumbling plastics, tires onto granulated rubber, etc.),
- recycling of energy – it allows to use the energy stored in certain waste materials (used lubricants and oils, seats upholstery, etc.), that are not eligible for products or materials recovery, such energy may be utilized for water heaters or electrical power generators.

According to the recommendations of the Council of the European Union, environmental determinants of recycling should be taken into account already at the design stage of vehicles. In the future, every car will be designed with criteria of angling towards total recovery without doing any harm to the environment. Therefore, there is a tendency to reduce vehicle mass and, consequently, to reduce fuel consumption and amount of toxic compounds released into the environment in the exhaust. The new, extremely simplified drafts of cars, deliberately limit the number of parts, for example the front mask, protective side moldings and grill are one piece. The maximum simplification of disassembling allows for easy unscrewing of fasteners. Engine covers, wings and rear parts of the car are made of polypropylene, materials derived from recycled plastic parts, and covered by thin color film, suitable also for reuse after reforming. Interior coverings are made of synthetic leather – natural and renewable material, produced mainly from waste leather. Silencing elements are light and effective, because they are made of the material consisting of two main recycled elements: fibers (mainly cotton) and polyester materials derived from recycling of bottles and packaging following waste segregation.

CONCLUSIONS

One of the most important problems the XXI century man has to face is the protection of the environment [Armitage 1995, Born, Sonzogni 1995, Cutter 1980]. A significant pollutant is the road transport, which is one of the most important industries, employs thousands of people and powers the development of the economy, science and technology. Means of road transport allow for and promote both people traveling and movement of goods, but they also trigger an increasing exhaust emissions and demand for fuel consumption. Unfortunately, hard-to-recycle materials are still used

for production of car components and tires. After they wear out, they contaminate the environment. A huge problem is the hundreds thousand of tires used every year, which require complex and expensive technologies in the recovery process of their components.

The list of the negative impacts of motor transport on the environment is very long. But we should be aware that education on the environmental threats is more and more effective, and being green becomes more popular. Many automotive companies work on reducing this negative impact. For example, there are numerous projects on the vehicles taken out of service or alternative fuels. Measures of supporting and developing the economic and social initiatives that contribute to the improvement of the environment are also undertaken [Kuderowicz 1993].

Authorities of each country or organizations (e.g. European Union) play an important role in overcoming the environmental problems of road transport, both in the scope and the methods for identification and evaluation criteria to foster environmental issues. They are responsible for the formulation of relevant standards and regulations inhibiting the materials and energy consumption, manufacturing and operation costs as well as for the recycling of worn-out vehicles. Appropriate environmental safety regulations also apply to the activity of transport supporting facilities, which are necessary for proper vehicle use.

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PROBLEMY EKOLOGICZNE TRANSPORTU SAMOCHODOWEGO

Streszczenie: W artykule przedstawiono wpływ transportu samochodowego na środowisko naturalne. Wymieniono i scharakteryzowano główne zagrożenia ekologiczne generowane przez transport samochodowy. Dodatkowo przedstawiono prowadzone działania proekologiczne w sferze produkcji, eksploatacji pojazdów, infrastruktury transportu oraz działania dotyczące zagospodarowania wycofanych z eksploatacji samochodów.

Słowa kluczowe: transport samochodowy, ekologia motoryzacyjna, związki toksyczne spalin