

METHODS RESTRICTING EMISSIONS FROM ROAD VEHICLE

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Summary: Air pollution is a problem in some cities. The paper deals with air pollution impacts on nature and human health. It also provides methods of reducing air pollution in certain areas (for example city centre) and states the experience with such methods in European cities.

Key words: Traffic prohibition, Restrictions on entry, Traffic charges, Reduction of exhaust gases, Effect of air pollution

INTRODUCTION

Worsening air quality in the Czech Republic is a serious problem. There is the worst air quality in Europe in some areas of the Czech Republic. This is caused mainly by industry but also automobile transportation contributes to this situation.

Local environmental degradation occurs for example in intersection. There is also more traffic noise and air quality decrease. The combination of the automobile and transport industry creates a large amount of air pollution. The aim is to reduce the main sources of pollution which are mainly factories, power plants, etc. If we consider vehicular traffic on the whole it is also a major source of air pollution.

With the growing number of cars, there is increasing number of pollutants in the air from automobile traffic. There are many methods for reducing harmful substances in exhaust gases. These can be technical that can improve the air quality consistently. There can also be various restrictions or bans on traffic in cities or urban areas.

The aim of this work is to determine the options for reducing pollution from cars and briefly describe their principles reduce.

1. EFFECT OF INCREASED POLLUTANTS

Air pollutant substances are causing many environmental and health problems. Here, only the effect of smog and acid rain is described in more detail.

1.1. Smog

When air pollution levels exceed a specific air pollution limit, a smog situation arises and it is a situation in which the air is extremely polluted. Smog is chemical pollution of the atmosphere caused by human activities.

There are two types of smog: London smog and Los Angeles smog.

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London smog, also known as reduction smog, is characterized by a mixture of smoke, sulfur dioxide and other gaseous exhaust, resulting from the combustion of coal at high relative humidity and it is usually accompanied by thick fog. Its ability to cause harm escalates in the presence of fly ash, which allows easy transport of gaseous components of smog to the deepest interior of the lungs.

Los Angeles oxidation type smog is sometimes called summer smog. This is an original mixture of ozone, peroxyacetyl nitrate, aldehyde and sulfuric acid resulting from the reaction of UV radiation with nitrogen oxide, hydrocarbon and carbon dioxide. We get it by burning liquid and gaseous fuels in air temperatures of 25 to 30 ° C on sunny days (UV radiation) and in wind.

Most types of today's smog are a combination of these two basic types.

Temperature inversion is a special weather condition, when the temperature increases with altitude and limited vertical airflow. These conditions are the most suitable for smog.

Establishment and termination of smog is announced by the Czech environment ministry, or they set up a legal entity. Legislation smog warning and control system are implemented in areas with deteriorated air quality. Regulatory measures are primarily concerned with stationary sources. Regulatory measures can be declared in the shortest time only by stating the reason for the regulation and the territories which will be affected. Information about the publication of regulatory actions must be published on television and on the radio.

Epidemiological studies show a link between high concentrations of pollutants in the air and increased incidence of respiratory and cardiovascular diseases. Risk groups include children, people over 65 years and more men are affected. It is also found that high level of pollution damages the ocular cornea and surface layer of the skin, slows the aging of the reduces skeleton, reduced levels of antibodies, lowers birth weight, increases the incidence of immature children, increases the number of allergies found in children and increases the incidence of bronchial asthma in children. There is a risk of damage to germ cells and the formation of genetic defects, which are manifested by incidence of congenital defects. We are afraid of carcinogenic effects and their ability to cause cancer, particularly in the bronchi (bronchial cancer is distorted by smoking) of adults. Smog has a negative impact on vegetation, including agricultural crops. Ozone disrupts the function of cells, which causes damage to leaves and conifers and vital processes. Loss of forests (which increases the incidence of knock-on effects such as landslides) and a reduction in tourism e.g. in Alpine areas is result of damage to vegetation. Smog damages outdoor buildings and facades and promotes corrosion of various structures such as bridges and electric power transmission lines. (1, 2, 3, 4)

1.2. Effect of acidic rain

Oxides account for approximately 1/3 of acidification of rainfall in Europe.

Acidic rain has been shown to have adverse impacts on forests, freshwaters and soils, killing insect and aquatic life-forms as well as causing damage to buildings and having impacts on human health.

1.2.1. Soils

Soil biology and chemistry can be seriously damaged by acidic rain. Some microbes are unable to tolerate changes to low pHs and are killed. The enzymes of these microbes are denatured (changed in shape so they have no longer function) by the acid. The hydronium ions of acid rain also mobilize toxins such as aluminium, and leach away essential nutrients and minerals such as magnesium. (5, 6)

1.2.2. Forests and other vegetation

Figure 1 demonstrates the effect of acid rain on a forest in Jizera Mountains.



Source:(7)

Fig. 1 - Effect of acid rain on a forest, Jizera Mountains, Czech Republic

Some adverse effects can be caused indirectly by acidic rain the acid's effects on soil (see above) or high concentration of gaseous precursors to acid rain. High altitude forests are especially vulnerable as they are often surrounded by clouds and fog which are more acidic than rain.

Other plants can also be damaged by acid rain, but the effect on food crops is minimized by the application of lime and fertilizers to replace lost nutrients. (7,8)

1.2.3. Human health

Scientists have suggested direct links to human health. Fine particles, a large fraction of which are formed from the same gases as acidic rain (sulfur dioxide and nitrogen dioxide), have been shown to cause illness and premature deaths from cancer and other diseases. (9,10)

2. REDUCTION OF EXHAUST GASES EMITTED INTO THE AIR

Methods, which improve air quality is many. They can be divided into methods, which reduce pollutants emitted from cars prohibition or restriction of entry to certain sites.

2.1. Methods restricting or prohibiting the entry of certain types of traffic

These methods are based on the principle that the vehicle does not move, it can't pollute the air in the locality. Such methods are local and only involve a certain area of deteriorated air quality. Effort to reduce motor vehicle traffic in the area, but it will not discourage drivers from driving and chooses a different route. It means that pollutants discharge to air will be changed, they only move to other place and so desintegrate. It is Used especially in crowded city centres and thus improves the passability of the city centre.

Increased traffic in certain locations can be dealt with in different ways: traffic charges, traffic prohibition, restrictions of entry, support for other modes of transport.

2.1. Traffic charges

2.1.1. Charging for parking

Charging for parking is one of the easiest measures to reduce car traffic in city centres. Such measures are aimed at individual car traffic and for the drivers who want to visit the offices in the centre or go shopping. Charging for parking would discourage drivers from entering the city centre, compel the driver to park on the outskirts of the city and then go on public transportation or use public transport to get transport from home to the city centre. Charging for parking would only affected traffic, which passes through the centre of town. Charging for parking can't affect people who have permanent residence in the city centre. Furthermore, people who do not pay for parking or park outside of their on-site parking should be penalized.

Solving the problem of transport in the city centre by charging for parking is being capital of the Czech Republic (Prague), which created 3 parking zones and that are:

- **Orange** - The maximum allowed parking time is 2 hours. Price: 40 CZK / h (1,5 EURO/h) , 10 CZK /15 min (0,4 EURO / 15 min). Validity area: 08:00-18:00,
- **Green** - The maximum allowed parking time is 6 hours. Price: 30 CZK / h (1,15 EURO/h), 15 CZK / 30 min (0,6 EURO / 30 min) , flat fee of 120 CZK (4,60 EURO) for 6 hours. Validity area: 08:00-18:00. Both zones are equipped with parking machines, which accept coins: 1, 2, 5, 10, 20, 50 CZK,
- **Blue** - long-term parking for residents of Prague 1, and any company having its registered office in this area. Only cars with parking cards are authorized to park in this area.

Furthermore, in Prague trapping parking is being tested which are car park near the metro and public transport. Drivers who live outside of Prague, can park here and change to the metro, which gets to the centre sometimes even faster than by car. (10)

2.1.2. Charging entrance

Another way to limit the number of cars in the city center is charging entry. Charging can be for all modes or only certain types of transport. For example, Berlin is considering the introduction of charging entrance for trucks. The reasons are mainly the introduction of tolls on motorways and the possible transfer of heavy vehicles on urban traffic. Heavy road transport generates about 39% of emissions, although constitute only 4% of all traffic. This operation will be throughout Berlin and for vehicles heavier than 3.5 tonnes. Charging

entrance to the centre has been experienced in London, where the charge came into force in 2003. London had a big problem with congestion. The results are generally positive for example:

- Decrease in congestion by 30%,
- Reduction of the number of vehicles in the central area by 18%,
- No increase in the intensity of vehicles in remote areas,
- Travel time decreased by 14%,
- Increased reliability of public transport,
- Drivers became accustomed to charging without any problem because before the introduction of charging, a massive campaign was carried out and there was good communication with the public and interest groups,
- In 2003/2004, we collected 186 million pounds in tax,
- Speed of buses has increased by 6%,
- Decreased CO₂ pollution by 20%,
- Reduction of road traffic injuries by,
- 9% compared to 7% outside the area.

Congestion charge is usually paid by SMS. If the driver fails to pay, they receive a notice of non-payment, proven using a photo. The effects of charging in central London are so positive that the city is considering extending the charging zone.

Negative experiences relating to the introduction of charging for entrance to a city centre can be seen in the Norwegian city of Trondheim. The introduction of charging was in 1991 and in 2005, the charging was reversed. The reason was that there were on campaigns to promote the introduction of charging. Meanwhile, a new generation of drivers grew, who didn't want to pay for entry to the city. Therefore, there did not happen: Reduce the number of journeys or increase the capacity of existing cars.

We have only observed changes in the transport division of work and timing of journeys.

The introduction of charging for entrance to the city centre must be preceded by an information campaign and by ensuring the support of the people. Because people do not like paying fees, it is a difficult task. Not many citizens accept such changes because they believe that the only party that earns is the state institutions. But the money can be re-invested in the transport infrastructure. Introducing changes for entrance to the city centre brings profit and reduces congestion and thus reduce the quantity of pollutants discharged into the air from cars. (9,11)

2.2. Traffic prohibition

Traffic prohibition to the city centre may be limited only for freight or for any other means of transport. An exception may be public transportation. Traffic prohibition only for trucks could help to reduce congestion and would reduce transit traffic through the city centre. Furthermore, this would help reduce the amount of pollution emitted into the air in the locality because trucks are heavier and slower than passenger cars and therefore emit more

pollution. However trucks often travelled to the city centre to supply shops and businesses. These trucks must be allowed entry.

Traffic prohibition for all vehicles would be more efficient. Its use is appropriate only in small areas. Using this a pedestrian zone can be declared. Traffic prohibition in busy areas may involve complications and at the edge of the area, worsened air quality and congestion may occur.

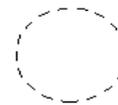
2.3. Restrictions on entry

There are many possibilities for restrictions on entry. Individual limits can be combined and can be more effective for reducing traffic than traffic prohibition. The purpose is to reduce traffic in the area and thus to avoid congestion and improve the environment.

One such limitation is a time limit. In a given time period, one type of transport may be banned or introduced, or some other restrictions may take effect. Time restrictions are introduced mostly during rush hour, or over the day. At night, the restriction does not apply and this time can be used for supply of goods to stores, etc.

In German cities (there are about 30) zones are introduced, in which a vehicle may enter only with a special ecological plaque, to be placed on the windshield. Drivers who don't have this plaque can not enter the zone or can expect a fine of up to 100 Euros. Ecological plaques are classified into four grades according to the emission levels of the vehicle. At the beginning of each zone is a sign indicating the zone and supplementary tables featuring plaques, which cars may use to enter the zone. At the end of the zone is a sign to draw attention to its end. According to the plaques there are 4 zones and entry to a certain zone is only allowed with the plaque for that zone or with a plaque of higher value (lower pollution, emissions).

1 emission level (no plaque)



2 emission level (red plaque)



3 Emission level (yellow plaque)



4 emission level (green plaque)



Source: (12)

Fig. 2 - Ecological plaque

For example, on the edge of Munich a car can enter with any plaque, but in the wider city only cars with yellow and green plaque can enter and in the centre of Munich only cars with a red plaque can enter. Plaques are issued for an indefinite period and depends only on the numberplate. The emission level of green plaques is determined by the emission of EEC / EC (ECE) in the vehicle registration document.

Tab. 1 - Distribution of vehicles according to the emission level

	vehicles of category M1, N1 (petrol engine)	vehicles of category M1, N1 (diesel engine)	vehicle categories M2, M3, N2, N3
EURO 0	none	none	none
EURO 1	green	none	none
EURO 2	green	red	red
EURO 3	green	yellow	yellow
EURO 4	green	green	green
EURO 5	-	-	green

Source:(12)

Older cars that pollute the air more can go only to the outskirts, where there aren't major problems with air pollution. Only newer cars with catalytic converters are allowed to drive in city centre, where heavy traffic and heavy loads of air contaminants are discharged. These newer cars are more air-friendly. (12, 13)

2.4. Support for other modes of transport

Public transport should be more supported. It should be competing with individual car traffic, that drivers do not use cars. The public transport that is competitive with automobile traffic must meet quality requirements. These quality requirements include the transfer speed (travel speed, number of transfers, waiting time the distance to the bus stop, etc.), comfort (temperature, climate, seating, overcrowding means of transport, etc.) and price. These requirements are individual, everyone has different priorities. Public transportation should offer quality services in particular where there is a limitation in other modes of transport so it can gain an advantage over individual car traffic. Reducing the intensity of traffic in city centres, etc. will increase the quality of public transport and particularly the speed and reliability of major buses and trams. The backbone of public transport should be railway transport. It is excellent for the town because the town does not burden the exhaust gases. The problem is in the production of energy for this mode of transport. In Czech Republic electrical energy is produced in thermal power plants so we can say that the pollution of the tramway is carried away from cities and to the areas surrounding the power plants. Moreover, better public transport vehicles with cleaner engines can be introduced, using grants for funding.

Another mode of transport, which is an alternative to individual car transport is cycling. This transport is mentioned also in the European Union transport policy. Cycling has environmental benefits, as it does not pollute the environment but also helps improve the health of the population. In order to increase cycling transport, it is necessary to build a quality infrastructure for cyclists, particularly good cycling routes and places where bikes can be locked. Furthermore, greater development improves air quality and weather conditions.

CONCLUSION

Using some of these methods will not solve the problem of air pollution. These methods can only help to reduce pollutants in urban air suffering from poor air quality or in smog conditions. It is necessary to contemplate methods for use in a specific case. Increased efficiency will help to combine them together or add a free public transport. It is needed to implement technical measures for cars for continuous air improvement.

The main ways to reduce pollutants emitted by motor transport involve the introduction of newer cleaner engines and engines that using alternative fuels. Reducing the cars would be difficult to achieve, as tough restrictions would have to be introduced and this would lead to indignation of the population. The introduction of more strict standards for combustion engines (EURO) is only a small step, it must be ensured that old cars will not be used and they will be replaced by new cars with Euro standards engines or with engine running on alternative fuel. Environmental tax can help achieve this. Normal things, such as higher prices, limited experience, distrust of people in new technologies, etc. prevent the introduction of alternative fuel engines. In the future we can expect a considerable expansion of these new technologies.

A division of labour among mode of transport, especially with freight transport, can also contribute to improve air quality. Vehicular traffic should be replaced in particular by rail and water transportation. Automobile traffic would be used only for delivery to final destination. Such solutions, however, need clean energy for rail transport and require eco-friendly cars.

Only the car traffic does not pollute the atmosphere. We should also use organic heating at homes and build factories in organic operations.

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