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AIR POLLUTION PROBLEMS IN EMR COUNTRIES

by

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INTRODUCTION

The interest of the World Health Organization in air pollution problems both at the international level and, in particular, in the Eastern Mediterranean Region stems from its duties to assist Member States in taking appropriate measures for the protection of health and the control of the environment. This interest is underlined by the responsibilities assigned to the Environmental Pollution Unit of WHO, the functions of which, in respect to Air Pollution, are as follows (WHO Document EH/68.1):

> To collect and disseminate information on the increasingly complex problem of air pollution, with special reference to the situation and trends in industrial areas and large towns, and facilitate exchange of information. To provide technical guidance on the prevention of air pollution and encourage the training of qualified personnel. To advise on air pollution control measures by technological and other means, such as administrative regulations and urban planning, and stimulate relevant work in this field.

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In accordance with the recommendations of the first WHO Expert Committee on Air Pollution, particularly in respect to the collection of information on sources of pollution and their control, and of further meetings including the second WHO Expert Committee on Air Pollution, which upheld and elaborated upon the conclusions of the first one, the interest of a number of countries of this Region was aroused and requests for WHO assistance were made to the Regional Office, with a view to surveying air pollution problems and submitting appropriate recommendations for control and in some cases simply for prevention. WHO was glad to co-operate and agreed to their request with the result that a number of WHO consultants have visited at least six countries of the Region to carry out air pollution studies. Their reports have been published and some of them have been distributed to the participants.

It is realized that the complete survey of air pollution problems in the Middle East cannot be made at once. This will take time; but from the WHO reports already published and from the reports of WHO project engineers, information has been gathered from which it appears that the air pollution problems in this Region are, in general, not severe. They may be related more specially to the following:

MOTOR VEHICLES

Motor vehicles are one of the main sources of air pollution and of complaints in many parts of the world. They discharge into the air tons of pollutants, which interfere with our comfort and can be detrimental to our health. It is worth indicating in this respect that in 1966 in the USA motor vehicles have discharged into the atmosphere 66 million tons of carbon monoxide and 12 million tons of hydrocarbons. As is well known, carbon monoxide can be quite toxic and hydrocarbons are very important in the formation of photochemical oxidants.

In the same context, it is of interest to note that, according to a study made in California, about 70% of the emission of hydrocarbons from motor cars come from the carburettor and the tank, and are lost through evaporation.

This study verifies that an improperly controlled vehicle will waste, as unburnt or partly burnt fuel, one gallon out of every ten gallons put into the tank. This may be unbelievable but it is a fact. This amounted in Teheran in 1964 to a loss through evaporation of about 28 million litres of petrol. This quantity has, of course, now greatly increased and may well have reached in 1968 60 million litres. The importance of controlling emissions from cars, even if it be only from the economic standpoint, is therefore obvious.

In general, air pollutants emissions from motor vehicles represent a problem in many countries, especially in the highly industrialized cities of Europe and America. In most of the Middle East countries, however, the situation does not appear to be serious. This is reflected in the WHO documents mentioned above. The information provided in this respect is summarized below:

Situation in Cyprus

In Cyprus, which was visited by a WHO consultant in 1967, the records show that the total number of vehicles licensed in 1965 was about 70 000 including 4 000 of the diesel type. The estimated consumption of fuel was approximately 120 000 tons/annum which represents an equivalent sulphur dioxide release to the air of about 2000 tons per annum. This has indeed very little significance. In fact, the total release of SO_2 for 1966 for all the fuel from petroleum products used in the whole island was not more than 12 000 tons per annum, for a total fuel consumption of about 350 000 tons, which is low. The conclusion of the survey is that there was no particular problem in relation to motor vehicles.

The growth of traffic in Cyprus is typical of a developing country in which people appear to have increasing means and increasing standards of living . Some advice was however given regarding the operation and maintenance of diesel vehicles, as they are likely to give off black smoke, which may, at times, be very objectionable.

Syria and Jordan

From WHO field staff reports it was learnt that in Syria and Jordan the further import of diesel vehicles has been prohibited by law. In Amman records show that in 1967 there were 4 600 diesel vehicles out of a total of 19 000 licensed vehicles. The liquid fuel consumed is produced at the Jordan Petroleum Refinery and the total production for the country was 393 000 tons for 1967 or about as much as is used in Cyprus. There is really no serious air pollution problem to report here. However, complaints about diesel vehicles exhaust have been reported, and it is assumed that this was one of the main reasons for prohibiting their further importation.

In Syria the total amount of petroleum consumed in 1968 is given as 1.58 million tons approximately, including 800 000 tons or slightly more than half for gas oil. Information is not available at the Regional Office concerning the problem of diesel vehicles in Syria but it may be assumed that complaints could have been received in this respect, resulting in the present prohibition of the import of diesel cars.

It should be pointed out in connection with pollutant emissions from motor vehicles that both petrol and diesel vehicles do not emit nitrogen and sulphur oxides to a great extent. From WHO Document WHO/AP/67.28 on the Public Health Aspects of Air Pollution from Diesel Vehicles it may be seen that "the sulphur content of petrol is sufficiently small to be ignored but diesel engine fuels commonly contain sulphur compounds equivalent to a sulphur content of the order of half of one per cent. Even so, the amount of SO_2 emitted under

normal operation is usually regarded as sufficiently small to be discounted as an air pollutant except, possibly, in circumstances where ventilation may be inadequate.

Teheran

The situation in Teheran was studied by Mr. Schueneman (reference document EM/ES/82) who provides relevant recommendations for the abatement and eventual control of the diesel vehicle problem.

As at July 1965 there was already in this capital city about 7 500 diesel buses and cars out of a total of 77 000 vehicles. Aproximately 375 000 m^3 of gas oil were used in the city for an equivalent SO_2 release to the air of over 6 000 tons per year, the total release of SO_2 for general fuel consumption in Teheran being 47 000 tons. This is, relatively, not very much, but what matters most, as pointed out by Mr. Ireland (reference EM/ES/94) is not the emission of sulphur dioxide, but the concentration reaching the lungs and it will be interesting to have the results of the monitoring programme for this gas. The total mass emission is not high, at present, compared with many modern cities, but it may increase with increasing industrialization unless natural gas becomes available in large quantities.

The problem of diesel engines as related to Air Pollution is discussed in WHO document WHO/AP/67.28. This document stresses that there is no justification for the attacks so frequently made against the diesel engine on the grounds of its supposed effects on health. It is true that smoke, although harmless, is accompanied by the formation of carbon monoxide and, in this respect, the continuous emissions of thick black smoke by an engine, labouring at the limit of its power, is both harmful and unnecessary. But if a diesel engine including its fuel pump is well regulated and maintained and the vehicles is well driven this is not likely to occur. As pointed out in the document, the very dense smoke should be blamed not on the engine but on the misuse of it.

On the other hand, it must be mentioned that carbon monoxide emissions which are so dangerous in heavy traffic, come mainly from petrol-driven vehicles, and hardly at all from diesels. In 1966 there was ten times as much carbon monoxide emission in the US from automobiles than from all the other sources combined. It will be recalled that carbon monoxide is very toxic and will kill at high concentration. At about 100 ppm, a concentration of which was found occasionally during observations in heavy traffic in Oxford Circus, London, and in Detroit, most people experience dizziness, headache, and other forms of CO_2 poisoning. The "serious level" of carbon monoxide, in the ambient air, adopted in the USA is 30 ppm for 8 hrs or 120 ppm for 1 hr, the "serious level" being defined as the level at which there will be alteration of bodily function.

The Smog Problem

Photochemical "smog" is another type of air pollution problem to which reference should be made in connection with motor vehicles. It results from the reaction of nitrogen oxides and hydrocarbons in the presence of sunlight. Smog can severely damage crops, reduce visibility, irritate mucous membranes and reduce resistance to respiratory diseases. It has been observed in a number of cities in the world and particularly in Los Angeles where hydrocarbons emissions are very great. 70% of them comes from the 3 1/2 million of cars circulating in the city.

Little information is at present available at the Regional Office concerning photochemical smog in this Region. It is thought that this type of air pollution may only occur in a few cities, possibly in Cairo or in Teheran where, as reported in WHO document (reference EM/ES/82), the general air pollution by nitrogen oxides and hydrocarbons might have, already in 1965, reached levels high enough to cause photochemical smog.

INDUSTRIAL SOURCES

The present information available regarding air pollution from industries in this Region is confined to the situation in Lebanon, Kuwait, Cyprus and the City of Teheran.

The problems appraised were often localized, as for example the Heri cement factory in Lebanon. As such they did not affect a great section of the population. However, in other cases the pollutants from the stationary sources were important enough to call for strong recommendations on the part of the consultants towards their abatement and control. Such was the case in Kuwait for the Chemical Fertilizer Company. A brief account is given below of some of the main sources studied.

The Cement Industry

Both in Lebanon and Teheran, there are a number of cement factories which were the cause of complaints from the population, especially in Lebanon. It will be recalled that the manufacture of cement is a dust-forming operation and that the complete elimination of dust is practically impossible. The most serious problem from a technological standpoint involves dust separation from the hot kiln gases.

In all the countries involved in the study, one of the main problems was, in effect, the lack of dust arrestors in the kilns resulting in important emissions of dust. The consultants have reported observing very dense plumes of dust being emitted from kilns. Without exception no tests were made to determine the dust load in the waste gases. The dust problem remains important and it is suspected that dust concentration is often above the recommended amount of 450 mg/m^3. It must be added that cement itself may also create a nuisance even greater than the dust from the kiln gases and every effort should be made to restrict cement dust from being blown about. However, it is satisfying to note that in all the countries visited, the packing and cement clinker grinding sections were fitted with bag filters which are very effective.

The other problem was the emission of hydrogen sulphide about which complaints were received in Lebanon and Cyprus. With the exception of the Lebanese plants, all the cement factory kilns mentioned in the consultants' reports were not fitted with oxygen indicators to determine the oxygen content. Finally, it was noted that in all cases the chimneys were not high enough to ensure perfect dispersion of the gases. As may be recalled, hydrogen sulphide can be tolerated up to a concentration of 5 ppm in the flue gases if the chimney is high enough.

The situation described above will not necessarily be the same elsewhere, but the general recommendations made by the WHO consultants can be useful. They concern the necessity of carrying out tests on waste gases from the kilns to determine whether dust arrestors are required, the need to provide bag-filters to cement-clinker and grinding sections and to make systematic tests for hydrogen sulphide. All new kilns should be fitted with proper indicating and control instruments to maintain oxygen content at the correct level of 1.5 % to 2 % minimum, and should have chimneys with adequate height and with an efflux velocity not less than 15 m per second at maximum production.

Brick Factories

This problem is mentioned as it constitutes quite a nuisance in Baghdad as well as in Teheran and possibly in other cities of the Middle East. Reports from WHO staff in Iraq state that great concern has been expressed by the authorities regarding brick factories to the extent that it has been decided to gradually eliminate them from the city's boundaries. According to the WHO engineer's report, the brick factories are very conspicuous with their thick black smoke indicating the type and extent of the air pollution problem created.

In Teheran, the situation is about the same. It has been reported that there are well over 200 brick factories in Teheran. Nearly all the kilns, in which the bricks are baked, are fired with a mixture of coal and oil which is heavy oil containing an average of 3% of sulphur. The kilns

produce a dense black smoke during a high percentage of the time they are fired. Some of the kilns are fired exclusively with heavy oil and air is injected into the furnace under pressure with the use of an air compressor. The proportioning of air and oil is said to be controlled by hand. The smoke problem is considered severe and the decision has been taken to encourage owners to move the brickworks for several kilometres to the south of the existing brick-fields and eventually into the desert.

Another observation made concerns the height of the kiln chimneys. Most of them have a brick stack about 30 metres in height, a few of them are only slightly higher than the kiln. The chimney will normally provide natural draft to assist combustion and its height and diameter are determined by the amount of draft required and the velocity of gas passing through it. If low chimneys are used, draft must be provided by fans.

The two WHO consultants who studied this problem are of the opinion that it is possible to obtain a better combustion by using in the first place either coal without addition of oil or by using a recognized grade of oil, and then by applying well known principles of combustion to the design and operation of the combustion equipment. In short, consideration must be given to proper air-fuel ratios and proper mixing and to sufficient ignition temperature and sufficient time to burn all the fuel. If required after-burners may be used. The above will apply to the various other light industries either in Teheran, such as the plaster works, or in some of the other countries visited by the WHO consultants.

Smoke will remain for some time to come the public enemy number one in the field of air pollution. Historically, the first air pollution ordinances were concerned with smoke abatement, because of its widespread occurrence. Although smoke reflects man's industrial progress, the scientist knows that it also shows man's inefficiency in converting fuel resources into useful energy. He also knows that technology is advanced enough to solve the smoke problem satisfactorily. Let it be hoped therefore that the action required

Refineries

WHO has little information concerning the air pollution problems created by refineries in this Region. From Baghdad it is learnt that the usual complaint concerns the unpleasant smell coming from gases emitted by the Daura Oil Refinery. In the immediate vicinity of the factory, damage to car paint has been observed.

It is realized that H_2S and the sulphur oxides, including probably SO_3 which would change into sulphuric acid in the atmosphere, are all involved, but no analyses of the flue gas have been made recently.

Air pollution problems related to refineries have also been reported in Kuwait but no measurement could be taken of the important gas contaminants for lack of measuring instruments.

However SO_2 and H_2S were intermittently smelt in some areas of Kuwait, particularly in the Shuaibah area. Ground level concentration of gases in suspected areas was estimated on the basis of stack design. They were found to be above usual concentrations (reference EM/ES/118). Note was also taken that one of the sources of air pollution was created by ground flares producing huge amounts of black smoke.

It is believed that similar air pollution problems related to refineries will be found in varying degrees in many other countries of this oil-rich Region. It should however be stressed that oil refineries have considerable air pollution potential and that great care and skill should be exercised in their design and operation.

This is a field for specialists and the petroleum industry needs many of them, as do the government authorities concerned with air pollution control. It may be noted that the new Air Pollution Engineering Manual (US PHS publication 999-AP-40) provides a number of suggested measures for reduction of air contaminants from petroleum refineries and thoroughly discusses various waste-gas disposal systems. This book which is in the list of background documents for this Seminar should prove very useful to air pollution control engineers and specialists.

It may be of interest to note that improvements in petroleum refineries technology are reducing refinery emissions considerably - waste-gas flares for instance which are used to dispose of gases collected from small leaks were once a source of great amounts of smoke, as is at present the case in Kuwait. Now they are mostly of the smokeless type, as air or steam is injected into the flares to promote combustion. Also the recovery of sulphur, contained in the crude oil, is widely practised. Sulphur recovery efficiency as high as 99% has been reported.

SOLID WASTES DISPOSAL

A special case of solid fuel burning which, from the point of view of air pollution control, has some importance in many cities of Europe and America, is the burning of refuse by industry and specially by municipalities. This problem may not be severe in the countries of this Region. However, it should be noted that, at present, in almost all of them refuse disposal consists of open dumps and/or open incineration only. No incinerator is apparently used except in Cairo where about 10% of the solid wastes can be accommodated in a small incinerator. 80% is disposed of by sanitary landfill and 10% is transformed into organic fertilizer.

The table below summarizes the situation in some cities of the Eastern Mediterranean Region of WHO :

City	Distance to Disposal	Tons/day	Disposal Method
Aden	21 km	approx. 20	Open dump, open incineration
Baghdad (Iraq)	9 and 5 km	1 650	Open dump, partial incineration
Chittagong (E. Pakistan)	11 km	170	Open dump, later destroyed by fire
Damascus (Syria)	12 km	200	Open dump, open incineration
Khartoum (Sudan)	8 km	230	Open dump, open incineration and filling borrow pits after burning
Riyad (Saudi Arabia)	20 km	210	Open dump, later destroyed by fire then covered with sand
Teheran (Iran)	25 km	950	Open dump
Zerka (Jordan)	6 km	2 650	Open dump

In the case of Baghdad and Zerka, where open dumps are relatively close to the city and the refuse collected more important, open burning of refuse, if practised, is likely to create a lot of nuisances, specially smoke which would add to the general air pollution problem of these cities. If refuse is to be burned, properly designed incinerators should be built, preferably of the multiple chamber type. If, on the other hand, refuse is disposed of by sanitary landfill, which is still one of the best known methods of solid wastes disposal when adequately carried out, there will be, practically, no air pollutant emission.

These questions were discussed in the recent WHO Short Course on the Collection and Disposal of Solid Wastes, held in Damascus, and should be kept in mind, specially where air pollution is of concern, when planning for better municipal waste disposal systems.

DUSTFALLS

In addition to man-made air pollution, the degree of which varies from place to place, the countries of this Region are in general suffering from another great problem due to natural causes, the sandstorms, against which very little if anything at all can ever be done. It is interesting however to mention the studies carried out in Kuwait by a WHO consultant to determine as exactly as feasible the amount of deposited dust from sandstorms. (Reference WHO document ME/ES/118).

For the purpose of this study collection of dust was made for the last twenty-two days of May 1968 and the results corrected for the whole month. The dustfall collectors used consisted of 1 litre cylindrical glass beakers, about 2/3 filled with distilled water. A table provided in the report shows that the average for nine stations excluding the Shuaibah industrial area and the fertilizer plant area was in the order of 400 tons per square mile, which is very high indeed. Dustfall would of course be much higher in the above two areas, (exactly 721.8 and 1464.0 tons respectively), because of the additional pollutants from the industries. In comparison, it may be recalled that the average dustfall for some cities, as given in WHO Monograph No. 46 on Air Pollution is as follows :

London : 97.1, New York : 85.8 tons per square mile, which shows how important the dust problem is in Kuwait.

The immediate effect of the storms is the decrease in visibility, the effect of which is so vital in various ways, specially in connection with plane landings and automobile accidents. The same document shows that in Kuwait the visibility is clear, being not more than 50 km., during 18.2% of the year only, and less than 5 km. or 3 miles during 6.2% of the year. The latter is the adverse level according to the Standards for Ambient Air Quality adopted by the California Board of Public Health. This situation is perhaps the same in Qatar and the other cities along the Gulf.

Another interesting study was published last year in the magazine "Atmospheric Environment" by the Pergamon Press and concerns the dustfall caused in Cairo by the spring storms known as the "Khamsin" storms. The study was undertaken by Dr. Abdul Salam and Mr. Sowlim, of the National Research Centre of Cairo. Cylindrical glass beakers, 17 cm high and 9.5 cm diameter were used for the study. The jars were changed every morning and evening, but if a storm should pass, the jars would be left in place until the weather cleared. Dust collected should consequently represent the dust deposited by the storm.

The results show that a very great amount of dustfall was collected. The figures obtained in tons per hour per square mile are 0.96, 1.95 and 1.41 for the three types of storms classified as coming respectively from the Mediterranean Sea, North Africa Coast and Central Africa. This amount is indeed considerable and the solution has been proposed by the authors that the Kattara Depression, which is on the way of the Khamsin storms and appears to contribute a great deal to the amount of sand in the spring storms of Cairo, be filled with water from the Mediterranean Sea. It is thought that "the filled depression would be a source not of dust and sand but of water clouds and in this way might diminish the volume of dustfall during the spring season".

It cannot yet be known for sure whether this solution will help to a great extent in the abatement of Cairo dustfalls during the spring, but the dustfall problem exists in sufficient degree not only in Egypt but in most countries of this Region to justify taking more effective action by all the authorities concerned with a view to preventing that additional pollutants be discharged into the atmosphere. The dust-storm problem is in effect unsolvable, and it will certainly pay very much not to add to it.

It is true that dustfalls have been occurring for centuries in the Middle East and that the people have learnt to live with it, but it is likewise true to state that industries are now expanding everywhere in this Region, polluting the environment, and that definite steps should consequently be taken to control these sources of man-made air pollution. This would very much prevent the atmosphere from approaching the limit of its capacities to absorb contaminants and would indeed provide for the very protection of the health of the people. To that end, the World Health Organization will endeavour, in many ways, notably in helping to train qualified air pollution personnel, to be of service to the Member States concerned.