Notes and miscellanea

Lead smelting at Avonmouth

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A committee was appointed on 29 February 1972 under the chairmanship of Sir Brian Windeyer 'to enquire into the circumstances which gave rise to the cases of lead poisoning at the RTZ Smelter at Avonmouth and to report in the light of the consideration at present being given by the Committee on Safety and Health under the chairmanship of Lord Robens to the general problems of health at work'. The committee reported to the Secretary of State for Employment on 23 June 1972.

Lead and zinc smelting has been an established industry on the site at Avonmouth since 1917 and there is evidence of earlier operations there going back to the eighteenth century. The responsibility for the current smelter had rested with the Rio Tinto Zinc Corporation since 1962. A new plant was commissioned in 1968 which was an expanded version of a well-established process operated by the company in the United Kingdom and in 10 other countries under licence.

The process consists fundamentally of oxidizing lead and zinc sulphide by combustion on a moving chain grate. The sulphur dioxide so formed is removed together with a mixture of finely divided oxides and eventually converted to sulphuric acid. The sintered oxides are fed into a blast furnace from whence the lead is tapped off at the base and the zinc is volatilized and sublimes in a condenser at the top of the furnace. There is no mention in the report of cadmium sulphide which is likely to be present as an impurity in the zinc sulphide and which would be converted to cadmium oxide during these operations. In particular, the first fraction of zinc given off during the blast furnace operation would probably contain most of the cadmium. The problems of cadmium

poisoning and the release of cadmium salts were not included in the terms of reference of the committee and hence were not investigated by them.

Between 1968 and 1972 there was a gradually increasing concern about the health of the workers on the site and about the possible pollution of the environment outside the site. The Factory Inspectorate had considered applying for a court order, the works doctor repeatedly drew the problem to the attention of the top management, and there was a loss of confidence in the management by the Trades Union. The company had tried to improve the performance of the plant while at the same time meeting the minimum standards of hygiene in the environment. The difficulties had been aggravated by frequent changes in local and higher management, a factor emphasized by the committee. Events were brought to a head by the death of a worker from an unrelated disease, and the diagnosis at a local hospital of lead poisoning in a worker certified as fit for employment by the company. Requests by the workers to examine the health register were refused and eventually a meeting of all parties, Factory Department, Medical Services, TUC Medical Adviser, works doctor, and company management, agreed to an early date for extensive modifications to be made to the plant by advancing the date for the annual overhaul programme.

The hazard to the health of the worker in this process arises from inhalation of lead dust and to a lesser extent from ingestion. Evolution of dust is likely to happen during maintenance and cleaning operations and particularly during unplanned shut-downs due to failure of the plant. The number of cases of lead poisoning notified to the Chief Inspector

of Factories since the new process began was 2 in 1968, 25 in 1969, 2 in 1970, and 11 in 1971.

The threshold limit value (TLV) for lead adopted by the Department of Employment is 0.2 mg of lead per cubic metre of air expressed as an eight-hour average per day for 40 hours per week. Many areas in the plant where men were employed had air concentrations which were consistently higher than the TLV, in fact as many as 62% of the readings were more than 10 times the TLV and some individual readings were in excess of 45 mg/m³. A further factor influencing the extent of exposure of the workers was the number of hours of overtime worked, which had increased because of the frequency of plant breakdowns.

From the beginning of the period (1968-72) various measures were introduced to protect the workers. These measures included modifications of the process designed to reduce air contamination, the issue of personal protective devices such as respirators, and protective clothing. Since 1971 smoking and eating have been prohibited on the plant and the workers are required to wash their hands and change the outer clothing before visiting a central canteen. Previously meals were allowed in workshops and a mobile canteen was used to provide light refreshments to workers on the job. The company did not accept responsibility for contractors' personnel on site.

It is important to have this background information before studying the committee's observations on the medical supervision at the factory. The Factory Department Regulations require a monthly medical examination together with three-monthly haemoglobin estimations. These examinations are designed to determine whether any of the workers show evidence of lead poisoning. The committee stress the emotive significance of the word 'poisoning' which was correct when the Lead Smelting Regulations were drafted in 1911. At this time severe symptoms and even death occurred as the result of excessive absorption of lead. At the present time the emphasis is on the detection of those workers in whom there has been an increased absorption of lead, before there is any injury to health. This is possible because of the refinements in the methods of determining excessive absorption, particularly by measurement of blood lead. The manifestations of lead poisoning observed at Avonmouth consisted of non-specific symptoms, e.g., lassitude, loss of appetite, vague indigestion, joint pains, and occasionally some degree of anaemia. All the cases notified to the Chief Inspector of Factories were investigated at Southmead Hospital and although there were a number of cases of excessive lead absorption, only mild symptoms were recorded and there was no evidence of serious or lasting damage to health. The efficacy and efficiency of the medical supervision

was justifiably complimented by the committee. In addition to the cases notified to the Factory Department the following numbers of workers were suspended from their jobs by the works medical officer—42 in 1969, 17 in 1970, and 40 in 1971. From 1970 onwards the works medical officer also carried out the medical supervision of contractors' employees.

Blood lead levels have featured more and more in importance in the diagnosis of lead poisoning and the assessment of excessive lead absorption. However, there is great variation in the amount of lead absorbed and in the response of individuals to the absorbed lead; and blood lead levels fall quickly on removal from exposure. In general terms, the average blood level of adults in the general public in the United Kingdom is less than 40 µg/100 ml of blood. Lead workers have higher levels but it is rare for any symptoms of lead poisoning to occur with a blood level of less than 80 µg/100 ml. Most of the workers admitted to Southmead Hospital had blood lead levels of between 80 and 120 µg/100 ml but some were much higher, the highest being 354 µg/100 ml.

The report rightly points out that medical supervision cannot prevent exposure, but can only deal with the situation after exposure and hence absorption has occurred. It should not, therefore, be regarded as the main safeguard to health but rather as a check on the effectiveness of measures designed to prevent exposure. The committee express the view that the right objective is to identify over-exposure rather than poisoning. It is recommended that the following levels proposed by Professor R. E. Lane and his colleagues (*British Medical Journal*, 1968) should be accepted as the best indication of tolerable levels of lead absorption:

(a) A blood lead of 80 µg/100 ml as an action level at which there should be particular supervision followed by suspension from work if the blood level increases or if there is a fall in haemoglobin concentration;

(b) A blood lead of 120 µg/100 ml should result in automatic suspension from work.

The committee comment on deficiencies in the original design of the plant, the undesirability of routinely wearing respirators, the problems of air monitoring and its relationship to particle size. These are all problems about which industrial medical officers and hygienists are painfully conscious. They also stress the importance of adequate communication with the workers, the proper education and training of the men concerned, and the development of the right attitude to hygiene so that all can appreciate the hazard.

There was no evidence that any harm had come to people outside the plant from the deposition of lead-bearing dust, but great emphasis was placed on the potential hazard to members of their families of

lead taken out of the plant by the workers on their clothes.

A number of recommendations are made: these include emphasizing once more that top management carry the responsibility for the protection of the health of workers; the importance of industrial hygiene and monitoring of the atmosphere, and the desirability of close co-operation of those concerned with the works medical officer; the education of the workers; and ensuring a flow of information to both workers and management about environmental contamination.

Finally, the committee highlight the need for research into a variety of problems ranging from a study of the relationship of particle size to lead absorption, the need for more knowledge about the significance of minor alterations in metabolism, and the accumulation of body burdens of lead, to the possible long-term effects of lead absorption in the absence of symptoms of poisoning.

The committee should be congratulated on producing the report within four months of its appointment and for the clear-cut assessment made of the unfortunate circumstances at the Avonmouth

smelter. The report should serve to crystallize a number of problems which have been a cause of anxiety to those concerned with the protection of persons exposed to lead in their work, in particular, the emphasis on the importance of distinguishing 'lead absorption' from 'lead poisoning' and its evaluation by reference to blood lead levels. There has been a need for some time to clarify in an official document the difference between poisoning and absorption and to specify the criteria which should be used in the assessment of persons who have clearly absorbed an excessive quantity of lead in their work.

References

- British Medical Journal* (1968) Diagnosis of inorganic lead poisoning: A statement. **4**, 501.
Report of a Committee under the Chairmanship of Sir Brian Windeyer appointed to inquire into Lead Poisonings at the RTZ Smelter at Avonmouth. (1972). Cmnd. 5042. HMSO, London.

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Long-term occupational exposure to the insecticides aldrin dieldrin, endrin, and telodrin

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Versteeg, J. P. J. and Jager, K. W. (1973). *British Journal of Industrial Medicine*, **30**, 201-202. Long-term occupational exposure to the insecticides aldrin, dieldrin, endrin, and telodrin. A medical survey of 233 long-term insecticide workers has previously been published. Fifty-two of them had left employment at the time of the original publication. All members of this group could be traced. No unexpected adverse effects on health were found. Their disease pattern and general well-being were not different from those in the original group.

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