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THE CONTROL OF ASBESTOS IN THE WORKING ENVIRONMENT

THE BRITISH Occupational Hygiene Society and the Asbestosis Research Council held a joint all-day Conference on "The control of asbestos in the working environment" in London on 18th June 1969.

For the morning session Mr. R. H. Dent, Chairman of the Asbestosis Research Council, was in the chair. In his opening address he said that the conference had been timed to follow closely on the publication of the Asbestos Regulations 1969, and that he hoped that the discussion to follow would make clear to users of asbestos and asbestos products not only how they could best conform with the law but also how they could ensure that the risks involved were, if possible, totally eliminated. In his view asbestos products offered very real advantages over possible substitutes, and he believed that a sound and practical series of precautions had been drawn up which would enable them to be used with the minimum of risk.

Dr. J. C. Gilson, Director of the Medical Research Council's Pneumoconiosis Research Unit, then read a paper on "Asbestos Products and the Health Problem". World production of chrysotile (white asbestos) far exceeded that of the other principal types, crocidolite (blue), amosite (brown), and anthophyllite (white). As a fraction of world production of asbestos the output of crocidolite has been increasing but the quantity imported into the United Kingdom has fallen sharply, not only relatively but absolutely.

Various diseases were associated with asbestos. The first was "asbestosis", fibrosis either of the lung (classical asbestosis) or of the pleura. Most people were susceptible to fibrosis of the lung and the risk of developing it increased with exposure; it was possible that the severity of disease for a given exposure also depended on the type of asbestos. Classical asbestosis caused disability, shortened life, and after it had passed a certain stage seemed to progress even without further exposure. It might be possible to detect changes in the lung before this critical stage was reached, so that exposure could be stopped and progression be prevented. Fibrosis of the pleura, with or without calcification, could occur alone or in association with fibrosis of the lung. Alone it seldom caused serious disability. It was practicable to control dust to a level at which it was almost certain that lung fibrosis would not develop, and probable that pleural fibrosis would not.

The second disease associated with asbestos was cancer. Bronchial cancer was caused mainly by cigarette smoking but was also linked with asbestosis; possibly the risk depended on the type of fibre. The specific risk due to asbestos could probably be avoided by practicable dust control. Mesotheliomata of the pleura or peritoneum were rare, and to date the total number of recorded cases in the United Kingdom was only 550. Evidence in this country suggested that 70–80 per cent of these cases were

associated with asbestos. Perhaps 1-3 per cent of those occupationally exposed to asbestos developed these tumours, but they did not appear for about 20 years or more after first exposure, and could be initiated by short exposure, possibly to low concentrations of fibres.

Finally there were asbestos corns, which Dr. Gilson regarded as innocuous. In the subsequent discussion Dr. Walter Smither (medical consultant to the AEC) confirmed this, and added that if the spicules of asbestos were removed very early, which was not difficult, the corn either did not develop or disappeared fairly rapidly.

In discussion Dr. Gilson explained that we could not assume that all mesothelomata were associated with crocidolite. Moreover the numbers involved were small: only 60 cases a year were being put on the mesothelioma register whereas there were 26,000 deaths from bronchial cancer annually. Replying to Dr. R. Murray (Medical Adviser to the Trades Union Congress) he said that he inferred from the geographical distribution of mesotheliomata that the manufacturers of asbestos products had controlled the problem more successfully than had the industries making use of them.

Dr. H. C. Lewinsohn (Turner Brothers Asbestos Co. Ltd.) put the question "Is pleural fibrosis a forerunner of mesothelioma?" It was answered by Dr. G. Sheers (Plymouth General Hospital) who explained that the long interval between the time of exposure and the development of the tumour required very lengthy follow-up which had not yet been completed in a sufficiently large number of cases. Mesothelioma had been seen to arise in individual cases previously under observation because of pleural fibrosis, but it was too soon to estimate the degree of risk.

In the second paper, on "Hygiene Standards", Dr. S. A. Roach outlined the rationale behind the Society's hygiene standards for chrysotile asbestos dust. (*Ann. Occup. Hyg.* 11, 47-69, 1968*). He emphasized that the consequences of imposing air quality standards on industry were not known with any precision. The practicability of any given level of dust control depended on its cost. The establishment of the costs of attaining high standards of air quality would make it possible to be less arbitrary in stating required levels.

In discussion, Dr. Roach explained that the sub-committee's conclusions had been expressed in terms of fibre counts because their basic data were primarily in those terms. The firm evidence available related to a range of exposures up to 30 fibres/cm³. The greater than 5 μ fibre count which the sub-committee had adopted was one of several indices of dustiness which might have been used. The sub-committee recognised a correlation between the greater than 5 μ fibre count and the incidence of asbestosis. Their information was largely limited to asbestos textile manufacturing, so that if other asbestos-using industries produced a very different dust cloud, the standard recommended might be inappropriate in that form. There were certainly easier ways than counting fibres for measuring dustiness and provision was made for these in the BOHS standard.

Mr. B. H. Harvey (H.M. Deputy Chief Inspector of Factories), in a paper on "Legislation", outlined the difference between the Asbestos Regulations 1969 and the Asbestos Industry Regulations 1931. The new Regulations applied to every branch of industry instead of being limited to certain scheduled areas in asbestos processing. The employer was to be held responsible for working conditions even if the work was done on premises belonging to someone else.

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Employers had to notify the Factory Inspectorate before undertaking a process using crocidolite and before stripping old lagging containing crocidolite. Waste had to be handled under efficient forced draught unless it could be shown that it could be handled as safely without. Higher standards for respiratory protective equipment would be imposed particularly outside the asbestos industry proper. Provisions for cleaning places of work would be significantly tighter. New buildings intended for asbestos processing would have to be planned so that suitable hygiene standards could be maintained without difficulty.

The Factory Inspectorate would employ quantitative standards to decide whether the new Regulations applied and whether, if they did apply, control was adequate. In those factories to which the Asbestos Industry Regulations 1931 had applied, the protection they had afforded had been very considerable. Energy now had to be concentrated on those industries which had previously been uncontrolled and on inculcating a higher sense of responsibility about personal protection in those industries, occupations and jobs where the new Regulations were going to bite and did not bite in the past.

There was room for debate as to where the new Regulations applied—e.g. What is the level of dust? What is the level of exposure? What about intermittent exposures? What about life-time exposure? Are the control measures good? The close association developing between H.M. Factory Inspectorate and the Asbestosis Research Council to ensure that both bodies gave the same advice on such points was a new departure in the field of compliance with Codes and their enforcement.

In discussion, Mr. Harvey expressed the opinion that cost benefit analysis of hygiene practices was only applicable above a certain level of precaution. The Inspectorate was concerned with the problem that if one is going to provide an adequate standard of control, there was a good deal of straight hardware that was necessary and where more sophisticated considerations were inapplicable. He explained that although crocidolite was regarded as more dangerous than other types, there was no reference in the Regulations themselves to an arbitrary division of standards by a figure of 10 for crocidolite and there was no intention to legislate it out of existence. Nevertheless H.M. Factory Inspectorate would work to higher standards of dust control where crocidolite was involved than with other forms of asbestos.

Dr. S. A. Roach commented on the increasing desire of continental industrial hygienists to work in collaboration with their colleagues in the U.K.

In answer to a question from Dr. G. L. Leathart (University of Newcastle-upon-Tyne) on the practice in the shipbuilding industry of keeping masks in the same store as asbestos, Mr. Harvey explained that the new Regulations provided for the segregated storage of respiratory equipment. The difficulties with respiratory protection would be overcome by the introduction of more sophisticated respiratory equipment which would be more comfortable.

The afternoon session was chaired by Dr. S. A. Roach (President of the British Occupational Hygiene Society).

The first speaker, Dr. S. Holmes (Secretary, ARC) gave a paper on "Monitoring Techniques and Sampling Procedures". Not all instruments were satisfactory, because of the nature of the dust cloud - asbestos fibres do not approximate to

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spheres—so that the settling speed in air of quite long fibres, which depends on their diameter, is slow enough for them to be inhaled. Short fibres can be dealt with by the lung and removed, but the longer fibres remain and are believed to be the cause of asbestosis.

Early medical evidence had suggested that the important fibres were those in the 10–50 μ range, so it was decided to measure the fibres between 5 and 100 μ long, to cover this range and also to provide a useful yardstick for engineering control. The standard sampling method was the membrane filter, used in conjunction with an electric pump or a Draeger hand pump. Personal samplers had not found much favour so far in the industry. Phase contrast microscopy (×500) was employed for counting the fibres.

Because the technique was too slow for extensive manufacturing operations, the asbestos textile industry used the Royco automatic particle counter, which could be set to give a reading equivalent to a membrane filter count but needed to be regularly recalibrated against membrane filters. It could take repeated samples over ½ min to 10 min periods and could be fitted with a continuous recorder. It was most useful when only asbestos was involved. Where mixed dusts were encountered, as in the manufacture or use of asbestos-cement, brake linings and insulating materials, the membrane filter method was preferable, because the actual asbestos fibres could be counted.

The measurement of mixed dusts without a membrane filter required the use of compositional analysis (to separate the asbestos). Atomic absorption (estimating the magnesium content), infra-red analysis or, best of all, X-ray diffraction could be used. Where the concentration of asbestos is extremely low, the only method is electron microscopy and electron diffraction.

In discussion, Dr. Holmes saw no problem from the risk of fibres being deposited on the Royco probe, provided the parameters were right to give isokinetic sampling. The Hexhlet was not suitable to collect respirable samples of asbestos, because the horizontal elutriator was not effective for chrysotile asbestos fibres.

Dr. Holmes believed that while there was some scientific evidence for adopting a threshold limit value of 2 fibres/cm³ for chrysotile in relation to asbestosis, to divide this figure by 10 for a TLV for crocidolite as a safeguard against mesothelioma was completely arbitrary. Clearly a tighter standard for crocidolite concentrations would be required, however.

Asbestos subjected to high temperatures was converted to another material. It began to give off its water of crystallisation at above 450°C, the heat degradation products being amorphous magnesium silicate and forsterite. Animal experiments so far carried out had indicated that these products carried no health risk.

Dr. W. J. Smither, in a paper on "Medical Supervision and Control", outlined the points that should be looked for in initial and periodic medical examinations of asbestos workers.

In assessing the degree of exposure to which an employee was subjected one had to know the asbestos content of the product on which he was working, whether he was handling it unmixed or mixed with other materials and whether he was handling it wet or dry.

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The purpose of initial examination was to exclude from employment people more likely to suffer from the effects of exposure to asbestos. At initial examination an employee's National Health and National Insurance numbers should both be recorded. A careful occupational history since leaving school should be built up through questioning by an informed person. If a Medical Officer knows where and with whom a man has worked, he is quickly alerted to areas of risk. No employee's spectacles or lights should be overlooked. Particular points of concern were raised by factors which might make the wearing of a particular mask difficult or impossible, to have various types of mask available, pre-existing disease of the chest, bronchial troubles, hypertension and rheumatoid arthritis.

The aim of periodic examinations was to detect at the earliest possible stage any deterioration in a worker's health. In guarding against asbestosis a series of chest X-rays should be taken and preserved. Significant sickness absence should be noted. One should look out for the symptoms of cough, shortness of breath, sputum and bronchial infection. Statistics from an asbestos factory showed that improved control of the working environment had extended the latent period, before asbestosis became evident, from an average of 7 to an average of 17 years, although improvements in radiological techniques had made certification earlier in the disease.

It was now possible to measure interstitial fibrosis by measuring the amount of carbon monoxide which passes from the air to the blood in a given time. A decrease in this amount indicated a thickening of the alveolar capillary membrane.

One result of these measures of medical control was that asbestosis cases were being diagnosed earlier, at a stage when disability was only of the order of 5–10 per cent. Dr. Muriel Newhouse's studies of a population had also suggested that a group which had periodic medical checks had a lower incidence of asbestosis and of cancer of the lung and pleura. The numbers in the study, however, were too small to be statistically significant.

In discussion, Dr. Smither explained that the wearing of a respirator was not yet a condition of employment. In any case he took Legge's view that until everything had been done which did not demand any cooperation from the workman at all, the employer had not done enough. The workman must be protected by engineering techniques before he was asked to cooperate.

The employment of ex-coal miners in the asbestos industry presented problems. Dr. Gilson thought the decision on this depended on the particular circumstances and the dust conditions at the place and time. Dr. Smither rejected a very small proportion of them. Dr. Gilson knew of no evidence that miners as such were more liable to develop forms of asbestosis should they get an excess dose of asbestos, but pointed out that it would be difficult to differentiate radiologically the chest changes in the asbestos-exposed worker. Mr. R. Hunt (BBA Group Ltd.) said that ex-miners in Yorkshire who had worked with asbestos were found at post-mortem to have carbon in their lungs but remarkably little asbestos. At his company's Cleckheaton factory there had been no deaths or certifications of asbestosis among ex-miners. Dr. H. C. Lewinsohn (Medical Adviser to Turner & Newall Ltd.) did not debar ex-miners from entering the asbestos industry if their chest X-ray and lung function tests were satisfactory.

Dr. Smither thought that insulation workers, even if only 5–10 per cent of their

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time was with asbestos, should be examined regularly, if only for epidemiological reasons.

The final session of the day, in which a panel of experts dealt with delegates' remaining questions, was prefaced by a few short papers. Dr. R. Murray (TUC) asked what the philosophy of the calculated risk represented in human terms to the people exposed to the risk. Action was required to remedy the absence of a linkage of the medical records kept by the Health and Social Security wings of the Department of Health and Social Security. More industrial hygienists were required to provide the amount of measurement required to make the Regulations real. Workmen should be taken into the confidence of those who were making the calculations of risks, if the level of cooperation were to be raised.

Mr. A. A. Cross (Chairman, Environmental Control Committee of the ARC) explained that his Committee had been formed to study the problems raised by the new Asbestos Regulations for those affected by them, and to help them to comply with statutory requirements and achieve satisfactory hygiene standards.

Mr. W. P. Bamblin (Environmental Control Committee, ARC) said that doctor, engineer, physicist and production man should work as a team to promote good conditions in the working environment. Six questions should be asked in relation to dust suppression: Do we need to do this operation in this way? Do we need to do it at all? Can we wet it? If we cannot wet it, can we at least damp it? Can we enclose it? Can we ventilate it? Detailed capital and running costs of various dust suppression systems were available from the ARC.

Mr. P. Swift (Technical Director, Dust Control Equipment Ltd.) outlined the four basic elements of any dust control system—hooding, interconnecting ducting, collector and fan. So very often the design of hooding was not given the attention it deserved, bearing in mind that the effectiveness achieved in hood design controlled to a large degree the total effectiveness of the installation.

The conference was summarised by Dr. S. A. Roach, its co-Chairman, at the end of the afternoon.

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