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FOR THE YEAR

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of the Committee newly set up under the Radioactive Substances Act to deal with the growing problem of radioactive waste disposal. The Factory Inspectorate has responded to appeals by various bodies for advice on the safety of exhibits containing or demonstrating radioactive materials at public exhibitions.

During the year the plans for the first commercially built research and training reactor in this country, of the " swimming pool " type, moderated and cooled by light water, were submitted to and approved by the Department. The reactor is intended to be " critical " in 1957 and will employ an enriched uranium oxide fuel, containing 20 per cent Uranium 235, giving a maximum power output of 5 Megawatts.

It is of considerable interest to note the growing number of well-known insurance companies (three of which consulted the Chemical Branch during the year) which have arranged for members of their staffs to make a special study of the problems raised by the increasing use of ionising radiations in factories and research organisations, with a view to providing any special insurances necessary to cover accident, storage, fire and contamination risks, etc., in which ionising radiations or radioactive material may be an adverse factor; these companies have supplemented their normal services to industry by giving advice on the precautions which should be taken to ensure the safety of workers in this field.

The Factory Inspectorate's advisory pamphlet, Form 342, " Precautions in the Use of Ionising Radiations in Industry " has sold more than 3,500 copies since it was first issued in 1953, and as it has been based on the Draft Regulations, it is not expected that these, when made law, will involve industry in any unexpectedly heavy burdens in complying with them. During 1956, as in previous years, a number of institutes, trade associations and private firms used Form 342 as a basis in drawing up detailed codes of practice to cover their own special requirements, and submitted these to the Inspectorate for criticism before putting them into use.

CHAPTER 15

Asbestos Industry Regulations, 1931

ASBESTOS is used widely in industry on account of its fire-resisting properties and fibrous nature, and the Asbestos Industry Regulations apply in almost all factories using the material.

The toxic nature of the dust has led to a search for a less harmful but equally effective material, but it must be admitted that for most uses a suitable alternative has not been found. Fibreglass has been used in place of asbestos for insulating bulkheads in ships, and a dolomite rock has been used for heat insulation, but these are only isolated cases, and there is no doubt that asbestos will continue to be used extensively in industry.

In addition to asbestos preparation, asbestos-textile and asbestos-cement sheet manufacturing, the Regulations apply also to such processes as the making of lagging compounds, the use of asbestos as fillers in paints and plastics and the cutting or abrading of articles containing asbestos. The processes vary considerably, and methods of complying with the Regulations take many forms.

One very hazardous process, to which the Regulations do not always apply, is the removal of old heat-insulation lagging. The handling of this very dry and dusty material presents a serious health hazard, which is all the more serious because the work is often done in confined spaces. Much of this work is done in premises not subject to the Factories Acts, and in any case the operation does not take long. The persons who do it are, however, regularly engaged on it and are constantly exposed to risk.

As would be expected from the diversity of processes to which the Regulations apply, the premises concerned vary in standard from the best to the very worst. In recent years the large users of asbestos have improved their premises very much, and some smaller firms also have made improvements. There remain, however, some factories in premises where satisfactory compliance with the Regulations is almost impossible.

On the whole there has been, as a result of a fuller realisation of the hazard by occupiers, a general improvement both in the premises used and in the standard of compliance with the Regulations. Mechanisation of fibre-handling, which has allowed this part of the process to be enclosed, has played a large part in making improvements possible. For example, at one of the large asbestos works, very great care has been taken in the design of enclosed plant, which is kept under slight negative pressure. At this works, asbestos, after it has been through the disintegrators, is with very few exceptions handled mechanically in enclosed chutes and conveyors, and, as an example of improvements in the enclosure of plant, recent alterations in the sectional-pipe making plant may be quoted. Loose asbestos is fed mechanically on to the lattice conveyors by which it is carried out, being subsequently damped and moulded round mandrels to form the pipes. The asbestos is still in a dry state when it is fed on to the lattice conveyors, so that this part of the machine is intended to be enclosed and under exhaust draught ; the material has, however, to be levelled by hand-raking, so that sliding doors were fitted in the back of the machine to enable this raking to be done from time to time. Inevitably the doors were left open and dust escaped ; spillage of loose asbestos also took place, throwing dust into the atmosphere. Recently the back was enclosed by a fixed panel with perspex inspection windows ; in the panel a small hole was left, through which a rake consisting of a bent rod could be used with ease. No loose asbestos can now be spilt on to the floor. The opening through which dust might escape is limited to the small hole through which the rod is inserted, and this opening has been shrouded with rubber, thus making the back of the machine virtually dust-proof.

Occupiers generally are far more aware than formerly of the risk associated with the use of asbestos, as is shown by the large numbers arranging for voluntary medical examination of their employees. All employees in the industry are, of course, medically examined at regular intervals under the Pneumoconiosis and Byssinosis Board Scheme operated by the Ministry of Pensions and National Insurance, but occupiers like to have reports on their employees at more frequent intervals and some like a pre-employment examination. Usually, clinical examination is supplemented by an X-ray examination, either miniature or full-size. Very often the examinations are carried out by consultants attached to the local chest clinic. It is reported that at two factories workers are never employed on the more dusty processes for a period exceeding five years, even if they show no signs of asbestosis. No doubt many other occupiers would like to change workers periodically from dusty to less dusty processes, but in many factories the hazard is comparable in all parts, and no advantage would accrue from change of process.

The Asbestos Industry Regulations are directed almost entirely towards the prevention of the inhalation of dust. Unless the material is damp, dust can be produced in almost every process covered by the Regulations, although perhaps the greatest concentrations are likely when the material is crushed and when the dry fibre is handled.

As indicated above, much can be done to prevent dust from entering the workroom if all handling is done mechanically in enclosed plant. At a large asbestos-textile mill the whole of the preparatory processes are being modified with this in view. Asbestos is received at the factory from abroad in a partially opened state and has to be fully opened, mixed, blended and in some cases crushed as well. One of the main hazards has been at the blending and mixing stage, as a very large proportion of the asbestos used in the factory is stack-mixed, a type of process common in fine cotton spinning mills. The different kinds of asbestos are placed in layers by hand on stacks containing 1,500 lb. Men using shovels or hand rakes then draw material from these stacks, and let it drop through floor openings to machines below. Exhaust draught is provided, but it is obvious that fine dust cannot be entirely prevented. The new system being installed will eliminate this entirely. Bags of raw material will be emptied under close exhaust ventilation into mixing drums, which will revolve to give a complete and thorough mix, and at the same time a quantity of oil, which will assist dust suppression, will be added. From the mixing drum the material will be automatically transferred to large hoppers and thence to willow machines, hammer mills or disintegrators, according to the nature of the material. From these opening machines, asbestos will be pneumatically fed through trunking to the next process, namely carding. This system has been tried and found to work. It means, in fact, that the asbestos will not see daylight from the moment when it leaves the bag in which it came to the factory until it is made into rovings on the condenser carding engines. The difference here is the difference between flow production and batch production. The criticism of present methods from the health point of view is that at several points the material needs to be bagged, weighed and emptied by hand. At each of these points, although close exhaust ventilation may be applied, the operator is near to the open material, and there is spillage, shaking, handling and, therefore, the evolution of dust. The new methods will also call for less labour, so that a smaller number of persons will be subject to risk. A further point of interest in the new plant is that provision is being made for diverting some of the material from the main hoppers to separate bagging points, at which considerable work has been done to provide automatic feed and weighing, so that the operator may come into contact only with the impermeable bag and not with the asbestos itself.

Regulation 8 (*b*), envisaging batch processes, requires the use of impermeable sacks for the transport of asbestos within the factory. In most factories there is good compliance with this Regulation. In some cases rubberised canvas is used but mostly one finds paper sacks. At one works fine calico sacks were introduced, but though these were much preferable to hessian sacks they could not be regarded as impermeable. Difficulty is sometimes experienced in filling impermeable sacks from hoppers because the air cannot escape through the fabric. Some factories have fitted an " air-balancer ", which allows the air to escape before the fibre enters. This Regulation does not apply to sacks in which asbestos is delivered to a factory. Most asbestos received from abroad is in hessian sacks, which do not retain the dust. They are also often torn, and the consequent spillage results in dust entering the air of the workroom. Many occupiers are trying to get deliveries in impermeable sacks, but so far they have not been successful. The suppliers claim that paper sacks are likely to be

broken in shipping, but judging by the experience with the shipping of ceme there does not seem to be much foundation for this objection. Factories whic obtain prepared fibre from works in this country can usually obtain it bituminised paper sacks.

When asbestos fibre is really wet, as in the moulding of asbestos cement shee there can be no dust problem. Damping to a lesser extent can reduce th amount of dust produced, and a number of factories are experimenting on thes lines. Several firms are now grinding and crushing, both in edge-runner an roller mills, with the fibre damp. Doubling of damp yarn is carried out at on mill, where it is hoped in the near future to wind all yarn in a damp condition Experiments are also being made in the weaving of asbestos cloth from dam yarns. These seem to be proving satisfactory, and one occupier hopes to b doing this regularly in a few years.

Owing to the variety of processes to which the Regulations apply, many type of exhaust ventilation are found in asbestos factories. Originally some firm relied on cross-ventilation of the workroom, but in the more modern plant the exhaust is applied close to the origin of the dust, and better still, many ingenious developments of the fume cupboard principle are to be found in the industry.

At one large works the Safety Officer, who for some years has specialised on the exhaust installation, considers that the whole secret of successful control lies in applying the exhaust at the point of origin of the dust; once the dust has formed a cloud in the atmosphere it is almost impossible to regain complete control. Wherever possible, plant at this works is totally enclosed and kept under slight negative pressure; where this is not possible, exhaust ventilation is applied on the cabinet or booth principle, the plant being enclosed except for openings necessary for the work. It is often found better to apply exhaust at several points, rather than have one very strong exhaust draught at a single point; for example, in each cabinet over the weighing points where sacks of raw asbestos are emptied into hoppers, there is one exhaust opening at the top to take dust escaping from the bag as it is emptied and other exhaust openings at the bottom to control dust arising from spillage on to the bottom of the cabinet.

A highly satisfactory standard of exhaust is reported from an asbestos-cement sheet works. The asbestos is first tipped into the enclosed crushing machine of each unit, and efficient exhaust draught is constantly applied both to the machine itself and to the place near the machine where the sacks are opened. The process of disintegrating and crushing is continued in an enclosed plant, until the asbestos, in a finely divided state, is discharged automatically into metal boxes on wheels. This discharge takes place inside a large fume-cupboard type of enclosure, the door of which is kept closed until the box is full and ready for withdrawal. The box is then removed and the material tipped into the inclined gridded opening of the nearby mixing plant. Exhaust draught is constantly applied at the mixing plant, and the tipping arrangements are designed so that there is practically no escape of dust into the atmosphere. The necessary quantity of cement is then added. Water is added inside the mixing plant, and the rest of the process in the manufacture of the sheets is wet, the machine used for the actual manufacture being similar to a paper-making machine.

In the preparation of cloth, asbestos yarn is often woven with other fibres or wire. A considerable amount of dust arises when power looms are used. For special purposes hand looms are still practicable, and with these there is little dust formation. The amount of dust from looms using chemically treated polished asbestos yarn is also negligible.

The application of exhaust ventilation to a loom is not a simple matter. Dust is produced at several parts of the machine and, because constant attention by the weaver is necessary, it is not practicable to enclose the machine completely in a fume cupboard. Although the methods employed vary from factory to factory, depending upon the type of loom and the cloth being woven, there is little doubt that there has been a great improvement in the exhaust at looms in recent years. In one instance, the dust is collected by hoods above the cloth at the front of the loom, and below the warp, both behind and in front of the sley. At another factory, the top hood at the front of the loom was adequate, but the dust from the warp threads was not adequately controlled. The firm therefore decided to enclose the warp threads in tunnels with tops of wired plastic and sides of american cloth. These allow easy access to the warp threads when necessary, and the dust is carried forward to the front exhaust hood. At another works, exhaust is applied at the fell of the cloth and also at the shuttle boxes.

For the making of asbestos mattresses, the ventilation has to be approved by the Chief Inspector, and it has been found that the larger factories work well within the limits of the approvals. Here again, the exhaust arrangement is mostly of the fume-cupboard type. In smaller factories too much work is sometimes taken on, when the exhaust ventilation becomes ineffective. At this type of works the manufacture of mattresses is often intermittent, and control of conditions by Inspectors is difficult. Regulation 3 requires, in addition to the provision of exhaust ventilation, that covers of mattresses, benches and floors should be kept damp where the making or repairing of insulated mattresses is carried on. Compliance with this is extremely variable, depending, it would appear, very much upon whether a fine rose for distributing the water has been supplied. There appears to be considerably less beating of mattresses than formerly. The most usual method of manufacture is to spread fibre over the cloth forming one side of the mattress, then to apply the other side and stitch round the edge. This removes one of the greatest hazards associated with mattress making.

At almost all factories subject to these Regulations the dust-separating plant is situated in the open air or in a ventilated room separate from the workrooms. In many cases mechanical shakers are provided for bag filters, the hazardous process of manual shaking thus being eliminated.

Breathing apparatus as required by Regulation 10 is normally provided by the factory occupier. This invariably takes the form of an approved dust respirator, rather than a helmet or facepiece with air-line, probably because the respirators allow the wearers greater freedom. It would appear that the respirators are reasonably comfortable, since little difficulty is experienced in getting workers to wear them.

CHAPTER 16

Chromium Plating Regulations, 1931

THE processes covered by the Chromium Plating Regulations include the electrolytic deposition of chromium on metal articles and the oxidation of metals, usually aluminium, by electrolytic methods. These processes are used widely in industry to produce both protective and decorative coatings.

Much of the decorative work is done in small factories, often housed in old premises. Inspectors report that even in these premises there is, on the whole, reasonable compliance with the Regulations, although maintenance of good