Occupational Hygiene and the Industrial Designer

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I do not propose to consider the problems presented by unsatisfactory conditions in existing factories and shall confine my remarks to the consideration of hygiene requirements when new manufacturing processes are developed and when the resulting production plants or factories are designed.

Industrial capital investment in this country is now at a very high rate (more than £1,000 million per year), the range of products is expanding rapidly, and the manufacturing processes involved are increasing in complexity. The resulting problems for the industrial designer are correspondingly great in number and complexity. The potential savings in capital and production cost to be derived from good design are very considerable and it is of the greatest importance that industry's development and design procedures shall be such as to yield the best possible results.

Stages in the Design of a New Plant

The creation of a new plant or factory makes a certain pattern; the principal stages are nine, and at certain of these the pattern must be closely integrated with the requirements of occupational hygiene. The nine stages are as follows:

1. Fundamental research in the fields of physics, biology, and chemistry, leading to the discovery of a new product and to determining the appropriate process for manufacturing it;
2. Applied research principally in the fields of mechanical, electrical, and chemical engineering and of metallurgy, leading to the evolution of methods of implementing the selected production process;
3. Process development and experimental work involving the design, building, and operation of semi-technical and pilot plants;
4. Preparing the technical flowsheets and specifications of requirements for the final production plant or factory;
5. Preparing engineering flowsheets based on the technical flowsheets;
6. Scheme layout design work covering buildings, plant, roads, railways, etc;
7. Selection or design of items of plant equipment;
8. Detailed design and layout;
9. Preparing final drawings for shop fabrication and for construction or erection on the site.

The requirements of hygiene demand attention to a greater or lesser degree at all these nine stages and contact with those who are to be responsible for the health and safety of the work people at the research stage is most important. There will be cases in which the difficulties introduced by the use of a particular process may necessitate an alternative mechanical method or chemical route, or additional medical investigations may be necessary before a plant can be designed with confidence.

If the designer is to have a clear understanding of all requirements before he embarks on developing his design, it is very necessary that hygiene requirements first studied in stages (1) and (3) should be fully stated at stage (4) and specified as an adjunct of the technical flowsheet. This specification must make known to the designer details of any health hazards associated with the various substances and operations employed in the process: it must, for example, inform him of the permissible concentration of a toxic gas in the atmosphere of a building so that he can determine what type of gland he must employ for process fans in the plant or whether the fans must be placed outside the building or perhaps in a cubicle. He must know if special washing facilities are required for workers handling a particular substance or whether the dust from the grinding of some material introduces a danger of pulmonary disease thus requiring special extraction equipment.

At the technical and engineering flowsheet stages it is not sufficient to examine matters only from the point of view of hygiene conditions in relation to operation; the maintenance aspect must also be closely considered since in many cases, for example, where radio-active compounds are handled, the hazards to health associated with maintenance may be such that either no maintenance is possible or replacement of consumable elements may have to be effected by remote control servo mechanisms.

In the later stages of design, particularly at stages (6) and (7), it is most important that the hygiene specialists should be in very close touch with the work of design and layout and they should critically examine what is proposed by the designer. The table on page 62, although not complete, emphasizes the necessity for close attention to hygiene requirements in the design of each element which makes up a complete plant or factory. In it I have set out factors under three main subject headings—environment, occupation, and amenities, but several of them apply to all three subjects.

The design problems associated with the factors in the table do not in themselves present any great difficulties: the technical issues involved are, with some exceptions, comparatively simple. The real problem is not one of design but of organization and procedures, one of ensuring that all the factors will be properly considered by the proper people at the proper time and that appropriate action will be taken. I suggest that the prerequisites for success are: (1) The availability of basic data and of specialist advice; (2) close and continuing cooperation throughout the design stages of the designer with those responsible for hygiene; (3) a full specification of requirements for satisfactory hygiene conditions; (4) critical examination of all plant design and layout proposals by those responsible for hygiene; (5) definite allocation of responsibility for matters of hygiene; (6) the interest and insistence of higher management in the attainment of healthy working conditions, and a real concern on the part of the whole design team for those who will have to spend their working lives operating and maintaining the plant.
### Table

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### Basic Data and Specialist Advice

The research workers, the development staff, and the engineering designers cannot be expected to have expert knowledge of hygiene requirements and must, therefore, be provided with information. This can be given by literature, which in suitable form is unfortunately scarce, or by medical officers with a specialist knowledge of occupational hygiene. A combination of both is desirable and to make this possible handbooks on the subject written specially for the industrial designer should be produced.

### Cooperation

The achievement of adequate cooperation must not be left solely to the research worker, the development staff, the engineering designers, and others directly concerned with the design work. Adequate cooperation often does arise from the natural interest of all these persons but if it is to be assured in the fields of health, safety, and welfare it must be positively organized by management.

### Specification of Requirements

Experience has proved the importance of a comprehensive technical specification from which to develop a manufacturing process, whether the process be a physical or a chemical one. The importance of a hygiene specification is equally great. I recommend very strongly that for all projects the requirements of hygiene should be the subject of a documentary statement prepared during stage (4) of the design.

### Examination of Design

Engineering drawings are not easily read or understood by medical officers, labour and welfare officers, and others outside the technical design team. Designers must devote adequate time to explaining their proposals, and I would particularly mention the value of isometric drawings and of models.

### Responsibility

Although it would seem that responsibility for matters of hygiene should be placed on a medical officer, I think it would in practice be better placed on the individual who will in due course be responsible for the operation of the plant or factory.

### Interest

The physicists, chemists, engineers, metallurgists, and other technical staff in the design team are naturally concerned primarily with their specialist techniques and hygiene is for them in general a secondary matter. An adequate interest in hygiene must be created if success is to be achieved. And this interest and a determination that plants and factories shall be healthy and safe places in which to work must come from higher management.

With all these prerequisites there still remains much in the way of routine procedures which will help to ensure success. I will refer to two procedures which have proved to be of value.

The first is the use of a specially prepared list of all issues which may arise in connexion with hygiene in the design of a plant or factory. This aide mémoire can provide an invaluable means for checking at every stage that all aspects have had proper attention.

The second procedure is one of recording that all interests have been consulted at each stage of design and that decisions taken have been implemented. The record provides a detailed history sheet of the project throughout all stages of design.

Working conditions in our factories are being steadily improved but there are still some black spots. These must and will be removed but it is more important still that by using sound design procedures no new black or even grey spots will appear. The provision of healthy, safe, and agreeable conditions for those who work in our factories is a moral obligation. It is also an economic necessity since these conditions, without doubt, play a great part in the achievement of maximum productivity.