



Health and the Factory Environment: The Medical Contribution

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ABSTRACT

Today's awareness of the ill-health potential of airborne particulate matter requires vigilance on the part of management and a continuing medical and hygiene program. Introduction of enzymes to detergent formulations in the late 1960s presented a health problem. New techniques for environmental monitoring, allied to high standards of individual and group medical surveillance with sophisticated analyses of the data were required. The multidisciplinary approach is described together with an assessment of the resource required and a summary of the medical results. Allied to the undoubted and accepted responsibility of management to safeguard the health of the workforce there is now legislation, already in existence in some countries, to reinforce this requirement. The key areas of the United Kingdom Health and Safety At Work Act are described to illustrate this.

In the past few years, I, as an occupational physician, became aware of the use of new raw materials, new processes, changed technology, and variations in products in the soap and detergent industry. These changes indicate progress in various disciplines, so it is my intention to try to paint a picture of parallel advances that have been made in my own discipline particularly affecting the soap and detergent industry.

The soap and detergent industry has had the advantage, or some might say disadvantage, of employing occupational physicians for a good number of years, and it is interesting when one looks back to find how the medical advice they have given has changed and evolved over these years. The major advances in thought, scientific appraisal or reappraisal of medical programs, and fundamental alterations in advice have really taken place within the past decade. I propose to use as a prime example in this discussion, the impetus given to these changes by the major introduction in this period of enzymes into detergents. However, lest you think that this



FIG. 1. Spirometry: technique.

paper is only about biological detergents, let me quickly disillusion you.

The example illustrates how some enzyme dust particles in the air when inhaled caused medical problems. But these particles could have been many other kinds of dusts, or fumes or vapors or mists; and the medical problems might well have been, or may in the future be, equally troublesome. So I would like you to concentrate, not only on biological detergents and enzymes in particular, but on all processes in your industry where dusts, fumes, or vapors occur in the factory environment and ask, "Could something similar be happening now, or might not something similar happen in the future?"

In these past few years, my profession, and I hope yours, has begun to come to grips with the ill-health potential of all airborne particulate matter and to organize programs to minimize or eliminate the possibilities of ill-health. This awareness has been achieved by most managements and is now impinging on the minds of governments in various parts of the world. Governmental actions have resulted in legislation designed to alleviate or nullify health problems of this type. It is my intention later in this paper to mention some of the current legislation and to touch upon its implications in this industry.

Now let us turn in a little more detail to our illustrative model: namely enzymes and the biological detergents. This is a particularly good study of how an industry, your industry, was presented with and tackled a problem that was suddenly thrust upon it and about which very few people at the time (and in this I include the medical profession) knew very much at all. It illustrates particularly well how considerable extra resource was required and produced, how steps were taken into an unknown field and how each problem, as it arose, was tackled vigorously and eventually overcome.

For the sake of simplicity, I intend to paint the picture as it appeared in the U.K. although, as you are well aware, the same scene occurred in many other countries including the U.S.

Although proteolytic enzymes had been incorporated into some washing products before the late 1960s, it was only in 1968 that they were introduced into washing powders in the U.K. on a large scale. These enzymes are derived from a naturally occurring nonpathogenic organism,

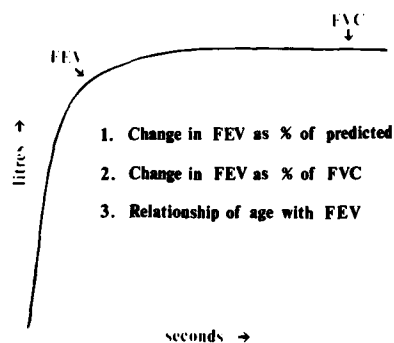


FIG. 2. Spirometry: trace and interpretation. Typical trace: male, aged 40; height, 6 ft; nonsmoker.



FIG. 3. The skin prick test: technique 1.

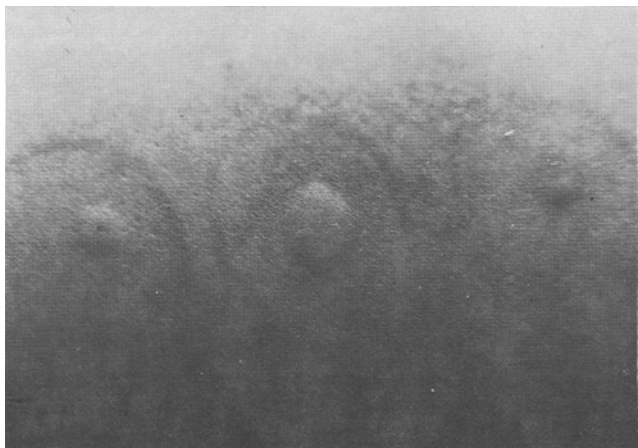


FIG. 4. The skin prick test: result response to three different allergens; 3, 5, and 10 mm weals.

Bacillus subtilis by a submerged fermentation process and supplied in a concentrated form such as Alcalase or Maxatase to the detergent industry. Henceforth in this discussion I shall refer to enzymes or Alcalase to mean any of the commercial preparations as used.

It was known at the time of introduction that proteolytic enzymes could affect the skin of workers. Precautions were taken in handling these materials, over and above the precautions previously considered for detergent manufacture. As a result, occurrence in severity in skin lesions and dermatitis had been minimal and no different from other detergent powders. Although previous manufacturing experience had given no indications that proteolytic enzyme dust could lead to respiratory allergy, this problem was quickly recognized within the industry. Factory programs to reduce dust levels and safeguard employee health were implemented immediately.

Let's digress for a moment to talk about allergy and the allergic reaction. The allergic response follows sensitization of an individual; the subject comes into contact with the allergenic substance, and he reacts by forming antibodies to that substance. At his next contact with the allergen, those antibodies can react, sometimes quite violently, with the substance causing either a generalized reaction or one localized to a particular organ such as the skin or lungs. The important point to note is that the amount of the allergen required to cause this reaction need only be extremely small.

1. Alcalase is an allergen.
2. Inhalation could sensitize the individual.

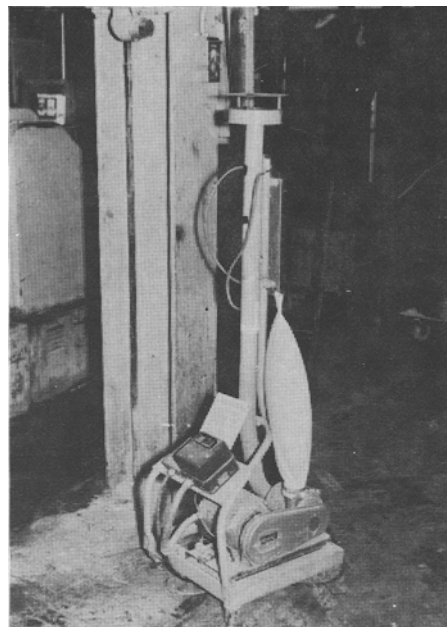


FIG. 5. The galley air sampler.

3. Subsequent inhalation could affect the nose and lungs.
4. The results were a blocked and running nose, and/or shortness of breath, and/or asthma.
5. The effects could last a few minutes or up to 24 hours.
6. Removal of the patient from Alcalase affected a complete and permanent cure.
7. Failure to remove could mean increasingly severe episodes.
8. Repeated episodes could lead to incomplete recovery and even long term impairment of health.

In September 1969, the U.K. Soap and Detergent Industry Association (1) (SDIA) formed a committee on enzymatic washing products to study the problem and to recommend standard operating procedures, dust monitoring techniques, and medical surveillance programs. The committee, together with its medical and technical subcommittees, included technical and medical members from the industry, observers from what is now the government Health and Safety Executive, advisers from universities, and was chaired by an independent medical consultant.

The SDIA Committee made its initial recommendations in November 1969. Full scale medical and environmental monitoring programs were designed and implemented.

In addition to these SDIA recommendations, an even more extensive program of special blood tests and full lung function studies was carried out on specific groups of workers.

Since 1969, the recommendations of the SDIA Committee have been continually reviewed, culminating in the "Medical Review of Workers in the Enzymatic Washing Product Industry in the United Kingdom 1969 to 1975" published in April 1976. This medical review was notable in that it was a study of the entire industry in the U.K. consisting of 2,865 people engaged in the production of enzymatic detergents. It was only possible by the wholehearted cooperation of management, workforce, and unions.

I can only give you an outline of the medical program, but I think it will be sufficient for you to understand the principles involved and the results achieved.

A pre-employment screening program was begun to prevent employment of persons likely to react to antigens. This group, which we shall call atopics, are those individuals

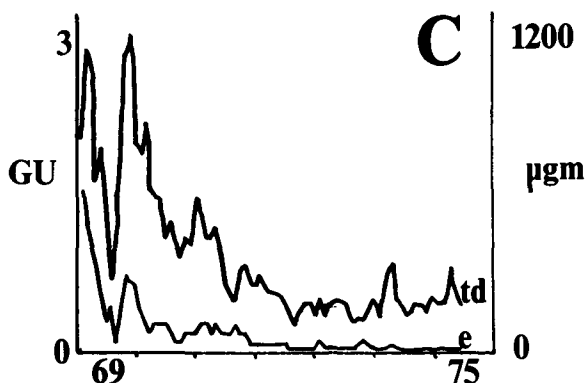


FIG. 6. Dust levels (mean monthly results of all samples). GU = glycine units of enzyme; μgm = micrograms of dust.

who normally suffer from such things as eczema, hay fever and asthma, and react to allergens. Having excluded this group of people it was necessary to do two things:

1. detect anyone who had symptoms relevant to Alcalase and remove them from exposure.
2. to detect any longer term trends.

As I have already said, the prime organ to be affected was the lung, and an adequate breathing test (Fig. 1 and 2) could detect both these two possible results. A skin prick-test (Fig. 3 and 4) was necessary in order to aid the diagnosis and to assess trends in sensitization of the workforce. Chest radiographs were taken at the beginning of employment and repeated at two yearly intervals. The whole program was based upon full clinical examination at regular intervals with immediate day-to-day assessment of any illness.

This program necessitated the development and full evaluation of the skin test procedure and also the preparation and standardization of skin prick-test antigens. The work was carried out by the industry, and was, in the field of occupational medicine, a major advance in techniques and testing procedures. It has since been ratified, copied, and used elsewhere.

Environmental monitoring was carried out on a regular basis with air samplers (Fig. 5) specially designed by the industry sited at fixed points throughout the relevant areas. The dust and enzyme dust levels were steadily reduced (Fig. 6), and it is against this background that the medical results should be judged. Unfortunately there is insufficient time to discuss the technical and analytical innovations necessary, all of which were quite new to this and any other industry.

The main conclusions of the "Medical Review" were that the lowering of dust levels was reflected in:

1. A reduction in the number of workers who became skin prick-test positive.
2. The reduction in the number of workers who needed to be transferred from contact with enzymes for medical reasons (Fig. 7).
3. The comparison of lung function tests between those workers exposed to biological detergents and similar workers not exposed; the lung function tests of these groups showed no statistically significant difference in any of the parameters measured.
4. There was no evidence of any long term lung disease in any of the workers studied.
5. Extensive radiological studies did not reveal any evidence of permanent occupational lung disease associated with enzyme or detergent dust.
6. Full serological studies (blood tests) on a cross-section of the population showed that any reaction experienced was due to a simple allergic response and no complications were detectable.

The program therefore achieved its objectives:

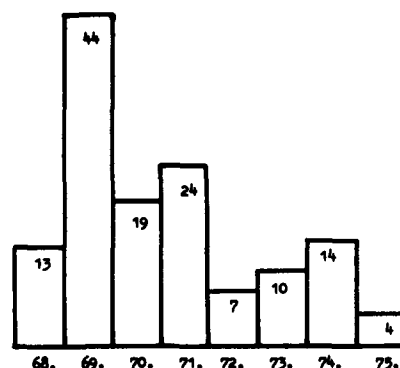


FIG. 7. Employees removed on medical advice.

1. Under normal operating conditions acute occupational illness had been eliminated.
2. During seven years (now nearly nine) no long term trends had been detected.

So much for a voluntary, successful, and continuing program operated by the U.K. industry.

Earlier I mentioned the subject of legislation. As you are all aware, there is legislation affecting occupational health and hygiene in existence in various parts of the world and pending legislation in others. As before, it is my intention to use as an example the legislation which was brought into being in the U.K. in 1974. In 1970 a committee was set up under the chairmanship of Lord Robens "to review the provision made for the safety and health of persons in the course of their employment..." As a result of this committee's findings, the Health and Safety At Work Act 1974 came into being and has profoundly affected every employer, employee, trades union, and ordinary citizen in the country. The Act laid down basic principles, but as with every other major piece of legislation designed to create new legal controls applying to the commercial community and to employers as a whole, provision was made for the detailed rules to be introduced over a period of time.

The primary purposes of the Act were:

1. To secure the health, safety, and welfare of persons at work.
2. To protect persons other than those at work against risks to health or safety arising out of or in connection with the activities of persons at work.
3. To control the keeping and use of explosive or highly flammable or otherwise dangerous substances, and generally preventing the unlawful acquisition, possession, and use of such substances.
4. To control the emission into the atmosphere of noxious or offensive substances.

The Act also set up a new enforcement agency, the Health and Safety Executive. The four objectives of the law are, therefore, not simply pious expressions of what legislators would like to see achieved in an ideal world but rules to be enforced. Failures to achieve these general objectives are likely to constitute criminal offences and are, therefore, liable to full legal penalties.

Now how does this legislation of 1974 affect the soap and detergent industry in the U.K.? Let us look back at the primary purposes of the Act — the first says that you should secure the health and safety and welfare of persons at work. This I believe needs no explanation; it provides legal requirements to do just what it says, and these legal requirements apply to employees in your industry. The second principal objective, to protect persons other than persons at work against risks to health, is an important addition to safety law, it identifies a theme recurring throughout this Act: that persons living in or passing through areas adjacent to workplaces must be protected against adverse consequences of what goes on in the work-

place. This is a new emphasis on an environmental aspect and as such is of particular importance to us. The third objective of controlling the use of highly flammable or otherwise dangerous substances does, of course, apply to the detergent industry. Detailed rules on these matters are following and are of particular interest to the Factory Inspectorate arm of the Health and Safety Executive. The fourth general purpose of controlling the emission into the atmosphere of noxious or offensive substances is also of importance to the soap and detergent industry. It is interesting that specific mention is made of emission of substances in circumstances where employees may be adversely affected as it seems they would be covered by the first objective. Where emissions affect the health or safety of persons other than employees, objective number two might seem to identify the law's anxiety. But it is the emphasis which is placed upon emissions that I believe is important for this fourth objective.

Now to these general provisions I would draw your attention to the duties of employers, particularly in respect to employees. There are five more specific duties of employers:

1. The employer must, as far as is reasonably practicable, make sure that plant and systems of work are safe and without risks to health.

2. So far as is reasonably practicable, there is an absence of risks to health in connection with the use, handling, storage, and transport of articles and substances.

3. The employer is obliged to provide information, instruction, training, and supervision to ensure, as far as is reasonably practicable, the health and safety at work of his employees.

4. The employer is obliged, as far as is reasonably practicable, to maintain the place of work in a condition

that is safe without risks to health.

5. The employer is obliged to provide and maintain a working environment which is, so far as is reasonably practicable, safe and without risks to health.

These are all legal requirements and as such apply to all industry and are in summary a widely worded general duty backed by criminal sanctions.

Before 1974 the U.K. SDIA medical program was drawn up and implemented voluntarily by responsible employers. Since the 1974 Act there are legal requirements making major parts of the program obligatory, and there is an enforcing body with powers even to stop processes and close factories. Times indeed have changed.

Finally I would like to draw your attention to the fact that since the detergent enzyme story, hardly a month goes by without the discovery of yet another occupational allergen — this is no exaggeration. In addition we have become aware of the medical potential of many other airborne particulates; their effects have to be evaluated and ill effects prevented. Your industry has had the experience of enzymes and of silica. It has tackled them and achieved success. It has, to a large extent, anticipated current environmental thought and practice, and anticipated legislation. The type of medical program required to deal with Alcalase is now becoming, and will become, accepted practice, even commonplace in tomorrow's industry. Legislation has already been enacted in some countries to reinforce the need for such programs. I can only believe that further legislation will follow elsewhere.

REFERENCE

1. Soap and Detergent Industry Association, "The Medical Review of Workers in the Enzymatic Washing Product Industry in the United Kingdom 1969 to July 1975," April 1976.