Introduction

Most of the basic studies on immobilization of biologicals were performed in the latter half of the 1950s. The thrust of those efforts were devoted to the bonding of enzymes. Towards the close of the following decade, the first commercial operation utilizing an immobilized enzyme, immobilized amino acylase, was established in Japan. The advent of this commercial system appeared to stimulate the imagination of those involved in enzyme immobilization. At this time the predominant thought appeared to be that immobilization was the panacea for the application of enzyme technology. Now, a quarter of a century after those first studies of immobilized enzymes, and with the application of fewer than twenty-five commercial processes involving immobilized enzymes, it is apparent to most of the scientists and engineers involved in the technology that there are marked limitations to its commercial application.

The potential of immobilization technology should not be viewed as marginal. Many exciting and lucrative applications have been applied and others are still under investigation. Certainly the application of immobilized glucose isomerase is one of those that have been judiciously applied and commercially exploited. In this case the enzyme costs were very high and the application would not have been successful had it not been for immobilization technology. Those applications that utilized low cost enzymes have been either marginally successful or failures. It is apparent, then, that at least for enzymes involving industrial processing a successful application will probably involve a high cost enzyme. Other applications of immobilized technology that have been successfully utilized are those involving enzymes for sensing, primarily in the health related field and immobilized microbes for chemical, drug, pharmaceutical, and waste processing.

Although this technology does not represent a panacea for the application of biological materials, we are now witnessing an expanding horizon for further exploration and commercial exploitation. The production of both animal and plant tissue cells and their products appears to be a very fruitful and exciting opportunity for this technology. Some of the topics included in this special issue devoted to the American Chemical Society's Division of Microbial and Biochemical Technology symposium, e.g., underwater life support, energy production and conversion, and blood deheparinization, are indications of the growth and diversification of the

technology. I have no doubt that this technology will make major contributions to essentials such as food, pharmaceuticals, energy, and therapy. We should, however, not repeat the mistakes of the past that sometimes involved unjustified and irrational approaches based on the concept of universal applicability of the technology.

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