

characteristics (oils, fats, polysaccharides);
Production of novel ingredients and flavours

D. SPECIALTY and COMMODITY CHEMICALS

World wide sales of chemical products were \$1,230 billion in 1991⁸. The chemical industry represents 10 % of the GNP of the OECD countries. Together with pharmaceuticals, specialty chemicals will dominate the scene for the next two years. Only a handful of specialty fine chemicals are currently produced using biotechnology processes. These include acrylamide, amino acids, ethylene oxide, pantothenic acid and adenosine triphosphate.

The chemical industry has been somewhat slow in accepting biotechnology as a viable production alternative. In the near term, the replacement of existing capital equipment is expected to be difficult, and biotechnological impact in the petrochemical industry for example is expected to be minor. Nevertheless, the potential for biotechnology innovation in chemicals manufacturing and extraction, is considerable.

It is likely that conventional manufacturing processes for commodity chemicals like sucrose, methanol, starch, paraffins, and lignocellulose will be replaced by biotechnological processes. In any event, biotechnology will focus preferentially on chemicals with large added values⁹.

E. ENVIRONMENT and MINING

In volumetric terms, the treatment of municipal waste water, sewage and toxic waste, is by far the largest biotechnological industry. The introduction of increasingly stringent environmental regulations is driving the search for effective and economic solutions. However, while much has been written about the applications of biotechnology to environmental problems these applications will mature more slowly than those industries discussed earlier. The reasons for this slower realization of possibilities is the processing costs of conventional technologies, the economics of raw materials, and full stop capital costs. Attention has focused on aspects of biotechnology involved in the microbial break-down of contaminated landfill, and the treatment of wastes and wastewater biofilters.

F. FLAVOUR and PERFUMERY

In 1986, the world market for flavours and fragrances was estimated to be \$6 million, with about 5% annual growth rate. The annual world market for food