

### 3. Chemical

The development of biotechnology in the chemical industry also has strong relations with the agricultural sector. Companies such as AVEBE, potato starch GLUCANA, gluconates use fermentation and enzymatic techniques. CCA BIOCHEM uses fermentation techniques to produce lactic acid, whereas DSM uses enzymatic production techniques to produce D-amino acids. DSM is also planning to use biotechnological methods to produce aspartame.

### 3. Environment

Biotechnological techniques have long been used to reduce pollution. At present, the Netherlands is regarded as a fore runner in this area. Several years ago, DSM installed the industrial aerobic/anaerobic waste-water purification plant, specially designed to handle nitrogen compounds. The new trend in biological waste-water purification is in the anaerobic field: the biothane UASB reactor "Upflow Anaerobic Sludge Blanket" was jointly developed by several universities and sugar manufacturers. Well known in Canada is PAQUES, a company which markets waste-water treatment systems. GIST-BROCADES developed an anaerobic reactor using the fluidized-bed principle.

An excess of manure causes an enormous contamination of soil with respect to copper phosphate and ammonia. Since 1978, over 30 manure convertors have been installed.

Other companies like the VAM, RUTTE and ACEC are specialized in the area of anaerobic digestion of domestic refuse.

Various research groups and companies are trying to clean polluted soil with microbiological methods in laboratory or pilot scale experiments. Whereas DE RUITER MILIEU TECHNOLOGY, MOURIK and BIOCLAIR are using on-site landfarming techniques.

### 4. Health Care

The most important area of research in the pharmaceutical and medical field is the development of novel monoclonal antibodies for therapeutic and diagnostic purposes.

Among the major Dutch companies AKZO developed new peptide hormones by replacing the costly chemical synthesis with recombinant DNA techniques to some extent. ORGANON develops diagnostics for human viral diseases. GIST-BROCADES and DUPHAR, an affiliate of SOLVAY are active in vaccine production.

Smaller companies are also active in medical biotechnology.

BIOINTERMEDIAIR is engaged in the production of monoclonal antibodies on a contract base. DE ROVER CHEMIE produces kilogram quantities of fine chemicals, including optical isomers.

### 7. Equipment

The biotechnology process requires custom-made equipment. APPLIKON DEPENDABLE INSTRUMENTS and CONTACT-FLOW developed a range of fermentation and auxiliary equipment, together with computerized bioprocess control systems. WAFLIN is developing membrane installations for reverse osmosis, ultra-filtration and micro-filtration.

A small but important portion of research is devoted to the development of suitable biosensors.