World Skill Development Institute

Enzymes Technology

Course Details

Course Duration – 1 Year

Course Description

Industrial biotechnology is the practice of using cells to generate industrially useful products. An enzyme is a protein that catalyzes, or speeds up, a chemical reaction. Enzymes are the focal point of biotechnological processes, without them biotechnology as a subject would not exist. The main advantage of enzymes compared to most other catalysts is their stereo, region and chemo selectivity and specificity. Enzymes are responsible for many essential biochemical reactions in micro organisms, plants, animals, and human beings. Biotechnology processes may have potential in energy production, specifically in the substitution of renewable plant biomass for fossil feedstock. This will depend on the development of enzymes able to degrade cellulose in plant biomass and designing methods to recycle or dispose of spent biomass. With time, research, and improved protein engineering methods, many enzymes have been genetically modified to be more effective at the desired temperatures, pH, or under other manufacturing conditions typically inhibitory to enzyme activity (e.g. harsh chemicals), making them more suitable and efficient for industrial or home applications. Enzymes are used in the extraction of natural products, as catalysts in organic chemistry, in clinical analysis, in industrial processes, and so on. The application of enzymes is found in many different fields and it is one of the good sectors to venture. In coming few years it is estimated that world enzyme demand will average annual increases of 6.3 percent.

This course basically deals with principles of industrial enzymology, basis of utilization of soluble and immobilized, enzymes in industrial processes, principles of immobilization of enzymes, enzymes in clinical analysis principles, practical aspects of large-scale protein purification, the applications of enzymes in industry, use of enzymes in the extraction of natural products, data on techniques of enzyme immobilization and bio affinity procedures etc.

This course can provide you all the basic information required on the fundamental aspects of the enzymes, their chemistry, bio chemistry as well as detailed information of their applications a wide variety of industrial processes etc. The course is very useful for research scholars, technocrats and entrepreneurs who want to enter into the field of manufacturing of enzymes.

Syllabus

1. LARGE-SCALE EXTRACTION AND PURIFICATION OF ENZYMES AND OTHER PROTEINS

Extraction by Chemical Methods

Alkali

Lysozyme and EDTA

Detergents

Cold Shock

Osmotic Shock

Extraction by Physical Methods

Sonication

Freezing and Thawing

Solid Shear

Grinding or Agitation with Abrasives

Liquid Shear

Isolation and Purification

Nucleic Acid Removal

Cetyltrimethyl Ammonium Bromide

Streptomycin Sulphate

Polyethyleneimine

Nuclease Treatment

Concentration by Precipitation

Ammonium Sulphate

Organic Solvents

High Molecular Weight Polymers

Concentration by Ultrafiltration

Concentration by Freeze-Drying

Gel Chromatography

Ion Exchange Chromatography

Ion Exchange Resins

Ion Echange Celluloses

Other Ion Exchange Gels

Affinity Chromatography

Coupling Techniques

Non-Specific Adsorbents

Hydroxyapatite

Celite

Hydrophobic Interaction Chromatography

High Performance Liquid Chromatography

Electrophoretic Techniques

Electrophoresis.

Isoelectric Focusing

Multimembrane Electrodecantation

Chromatofocusing

Aqueous Two-Phase Separation

2. PRINCIPLES OF INDUSTRIAL ENZYMOLOGY: BASIS OF UTZATION OF SOLUBLE AND IMMOBILIZED

ENZYMES IN INDUSTRIAL PROCESSES

Glossary of Symbols

Assay of Enzyme Activity

Cofactors

The Distinctive Features of Enzymes as Catalysts

Enzyme Catalysis

Enzyme Kinetics

The Effect of pH on Enzyme Activity

The Effect of Temperature on Enzyme Activity

Enzyme Inhibition

The Various Types of Enzymic Catalyst

A Comparison of Enzymes with Chemical Catalysts

A Comparison of Enzymes with Fermentations

Immobilized Biocatalysts

A Comparison of Immobilized Enzymes and Cells

An Assessment of Immobilization Supports and Methods

Characterisation of Immobilized Biocatalysts

Co-Immobilized Enzymes

Two-Phase Reaction

Industrial Enzyme Kinetic

Effects on Equilibria

Effectiveness Factors

Steady - State Kinetics

Intrinsic Activity of Enzymes - Modifying Factors

Introduction

Diffusional Limitations on the Activity of Immobilized

Biocatalysts

External Diffusional Limitations

Internal Diffusional Restrictions

Regeneration of Cofactors

Biochemical Reactors

Introduction

The Various Types of Biochemical Reactor

Assessment of the Performance of Biochemical Reactors

Batch Reactors

Continuous Stirred Tank Reactors

Plug-flow Column Reactors (or Tubular Reactors)

Fluidized Bed Reactors

Electrochemical Reactors

Ultrafiltration Reactors

Enzyme Kinetic in Reactors

Inhibition in Enzyme Reactors

The Effect of Non-Ideal Flow on Biochemical

Reactor Performance

Physical Problems in Biochemical Reactor using

Immobilized Biocatalysts

Abrasion

Compression

Fouling

Microbial Contamination

Choice of Immobilization Method

Outline of Properties of Immobilized Enzymes

Stability

Kinetic Properties

Outline of Enzyme Reactors

Batch Reactors

Continuous Reactors

Application and Future Trends

Analytical Applications

Enzyme Electrodes

Automated Analysis

Therapeutic Applications

Enzyme Replacement

Enzyme Therapy

Industrial Applications

Future Trends

4. ENZYMES IN CLINICAL ANALYSIS - PRINCIPLES

Measurment of Substrate Concentration with Enzymes

Principles of Equilibrium Methods

Principles of Kinetic Methods

Comparison of Equilibrium and Kinetic Methods

Common Indicator Species Used in Routine Clinical Analysis

Nicotinamide Adenine Dinucleotides

Oxygen and Hydrogen Peroxide

Measurement of Enzymes

Principles of Enzyme Assay Using Coupled Enzymes

Immobilized Enzymes for Measuring Substrate

Concentrations

Immobilized Enzyme Reactor Tubes

Bioanalytical Probes

Dry Reagent Chemistry

Enzyme Immunoassay (ELA)

Preparation of Enzyme Labels

Homogeneous EIA

Heterogeneous EIA

Choice of Enzyme Label

Assay in EIA

Simultaneous Assay of Two Haptens

The Future

5. PRACTICAL ASPECTS OF LARGE-SCALE PROTEIN

PURIFICATION

Enzyme Inactivation

Containers and Ancillary Equipment

Glass Vessels

Metal Vessels

Plastic Vessels

Liouid Transer

Couplings

Pumps

Bacterial Disruption

Use of Enzyme - General Comments

The Characteristics of Industrial Enzymes

Soures of Enzymes

The Isolation, Purification and Formulation of Enzymes

Legislation on the Use of Enzymes

Enzyme Manufacturers

Biochemical Applications

Use of Enzymes in Analysis

General

In Clinical Assays

Medical Uses of Enzymes

The Use of Enzymes as Catalysts in Organic Chemistry

Introduction

Stereospecificity of Enzymes

Prochiral Stereospecificity

Combinations of Stereospecificity

Multiple-Step Reactions

Synthesis of Radioactive Compounds

Restrication Endomucleases

Biochemical Processing

Applications of Enzymes in the Food Industry

Polysaccharide Processing

Bacterial -amylase

Amyglucosidase (EC 3.2.1.3)

Maltose Syrups

Glucose Isomerase (EC 53.1.5)

Inversion of Sucrose

Sugar Refining

Raffinase

a-amylase

Dextranase (EC3.2.1.11)

Debranching Enzymes

Cyclodextrin Glucosyltransferase and Other Amylases

Cellulase (EC3.2.1.4)

Ethanol Fermentation

Brewing

Baking

The Dairy Industry

Lactose Hydrolysis

Cheese Manufacture

Coagulation

Flavour Development

Other Applications

Organic Acids

Amino Acids

Introduction

Enzymic Resolution

Enzymic Production of Amino Acids

Antioxident

Introduction

Glucose Oxidase (EC 1.1.3.4)

Protein Processing

Introduction

The Plastein Reaction

Aspartame

Others

Flavouring Agents

Fruit Processing

Use of Enzymes in the Extraction of Natural Products

Detoxifying Enzymes

Enzyme-Based Detergents

Use of Enzymes as Cleansing Agents

The Leather Industry

Textiles

Paper Manufacture

Antibiotics

Penicillin Acylase, (EC 3.5.1.11)

Cephalosporins

Miscellaneous uses of Biocatalysts

Conclusion

Note in Proff

Acrylamide

Propylene Oxide

Vinyl Chloride

Biosensors

Amino Acids

7. DATA ON TECHNIQUES OF ENZYME IMMOBILIZATION

AND BIOAFFINITY PROCEDURES

Entrapment

Gel Entrapment

Fibre Entrapment

Microencapsulation

Phase Separation Method

Interfacial Polymerization Method

Liquid Surfactant Membrane Method

Liquid Drying Method

Chelation or Metal Binding

Covalent Binding

Diazotization

Amide Bond Formation

Acid Anhydride Derivatives

Acylazide Derivatives

Cyclic Imidocarbonate Derivatives

Isocyanatc and Isothiocyanate Derivatives

Acyl Chloride Derivatives

Cyclic Carbonate Derivatives

Condensing Reagents

Alkylation and Arylation

Schiff's Base Formation

Ugi Reaction

Amidination Reactions

Thiol-Disulphide Interchange

Mercury-Enzyme Interactions

-Irradiation Induced Coupling

Matrices for Carrier Binding

Inorganic Supports

Controlled Pore Supports

Other Porous Supports

Non-porous supports

Coupling Reactions for Inorganic Supports

Organic Supports

Polysaccharides

Proteins

Carbon

Polystyrenes

Polyacrylates

Maleic Anhydride Based Copolymers

Polypeptides

Vinyl and Allyl Polymers

Polyamides

Crosslinking

Immobilized Cells

Entrapment

Physical Adsorption

Chelation or Metal Binding

Covalent Binding

Crosslinking

Other Immobilized Biologically Active Moleccules

Immunoadsorbents

Affinity Chromatography Media

Immobilized Lactins

Immobilized Amino Ecids and Peptides

Immobilized Carbohydrates

Immobilized Nucleosides, Nucleotides and Nucleic Acids

Immobilized Antibiotics

8. ENZYMES IN CLINICAL ANALYSES - DATA

Substrates Measured Enzymically in Clinical Laboratories

Enzymes Measured by Coupled Enzyme System in

Clinical Laboratories

Immobilized Enzymes for Measuring Substrates

Enzymes Used in Enzyme Immunoassay (EIA)