

Solidstate bioreactors

Instrumentation through innovation

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SPECIAL POINTS OF INTEREST:

Design & construction of SSF

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A bio-technology news letter

State of art pollution free conversion of agricultural waste into useful byproducts is an important consideration in predominantly agricultural economies such as India, Thailand, Burma, Srilanka etc. Some amount of such material can be utilized for the production of Bio-fertilizers, such as worm compost etc. However a large number of waste products, some starches, vegetable oil, celluloses, hemi celluloses and lignin need processing before mass to energy conversion can be attempted. The most difficult situations arise when water insoluble components of plant cell walls are involved. Such materials are to be first de-polymerized to obtain water-soluble matter for subsequent bio-conversions.

Efficient and innovative solid-state processes are to be developed by applying Bio-engineering processes. Andhra Pradesh, Tamilnadu and Karnataka can take lead and experiment to develop products and processes in this field since a large number of engineering colleges have opted for teaching Biotechnology. The large professional body of fresh and uninhibited work force when deployed in this direction of research can make basic agricultural economies and rural scenario vibrant. Since the raw materials are plenty and the systems and equipment are simple and cheap commercial scale process development will yield rapid development of rural areas. Large No. of jobs can be created in rural India employing educated unemployed and financing the projects under Rojgar schemes will be an added advantage. The value addition, alternate employment for rural labor and finally making our institution responsive to the requirements

and realities of the rural India can qualitatively change the mindset.

At present most of these waste products are employed as substitute for energy by burning which can at best convert only 15-20%. On the other hand bio-waste to gasification converts 50 to 60% to energy, and 20% bio fertilizer can be realized. This will be three times more efficient and indirectly generate jobs as well as combat pollution.

What is solid state fermentation:-

It is the cultivation of micro-organisms on moist solid raw materials such as grains, beans or wheat bran. This is an alternate route to the cultivation of micro-organism in liquid nutrient broths in fermentor and stirred tank bio-reactors.

Solid-state fermentation has been used for centuries and is still relevant to largely agricultural based economies. Foods products such as Soya sauce and mushrooms are general examples. Infact the instrumented stirred tank, air lift and fluid bed bioreactors have come into use as parametric control and unit processes of chemical engineering can result in better yields.

However, recently the use of solid-state fermentor for the production of bio-pesticides has been attempted. Also certain health promoting substances present in Asian foods, revised the western interest in food processing by solid-state fermentation route.

In many cases the microorganism used in solid fermentation is fungi which is ideal for colonizing and penetrate solid particles. Fungi are very efficient enzyme producers and can make flavors and health promotion substances. These enzymes also act as natural antagonists to pests and save a large amount of food products from chemical pesticides that are toxic and deleterious to health even when present as residues in part per million quantities.

General Examples of SSF:-

1. *Spergillus oryzae* in Soya sauce production.
2. *Rhizopus Oligosporus* in making Tempe
3. *Penicillium Roqueforti* in making Roquefort cheese
4. *A garicus bisporus* in making edible mushrooms
5. *Coniothyrium minitans* as bio pest control agent.
6. Exoenzymes production by *lentinus eddoes* and *pleurotus ostreatus*
7. Lignin like compounds use in lignocelluloses
8. Use of redox and hydrolyte enzymes in the treatment of cellulosic films.
9. Solid state fermentation of wheat straw for paper manufacturer
10. Enigmatic treatment of non woody plants for rich pulp
11. Laccase and manganese peroxidase production
12. Immobilized laccase from *lentinula eddoes*
13. Tyrosol biotransformation from *lentinus eddoes*.
14. Growth of micro organism and filamentous fungi
15. Productions of exo enzymes by *lentinus eddoes* and *pleurotus ostreatus*
16. Protein production and laccase activity in *Agaricus bisporus*.

Design & Construction of SSF,

The SSF is basically a stationary mass type heterogeneous phase reactor. The mass is loosely packed and moisture as well as air and inoculants is continuously added. So basically a cylindrical vessel with large enough loading and material removal ports is used. Air or gas admitted and exhausted at a constant rate. The inoculants and/or the nutrient is added by spraying.

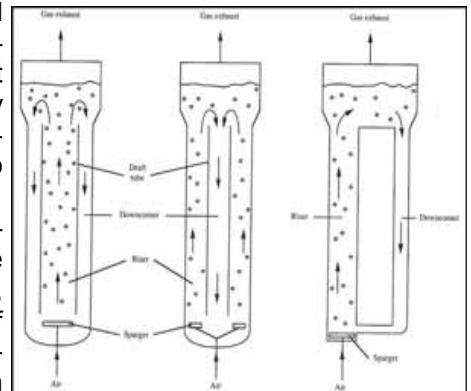
In yet another variation of the design the system is mounted on a roller table and rotated at a low speed. After a long period of operation with appropriate parametric controls the mass is squeezed to separate the products / enzymes for further processing.

Advantages of SSF

- No free water requirement greatly reduces the volumes of fermentations media, which in turn offer—
- Comparable yields and less volume of media per mass of substrate allow use smaller size fermentation equipment for a given product yield.
- Very little waste disposal requirement, less pollution and more eco-friendly. Higher achievable concentration and consequently less down the stream processing costs result in better economics.
- Since most bacteria need higher liquid environment, can not thrive in SSF conditions so operating conditions are less critical and do not require stringent sterilities.
- Simple naturally occurring media hence less expensive, larger plants at affordable investments. Less capital intensive, best suited technology to rural India

Disadvantages and areas of research.:

- Poor removal of large metabolic heat generated by microorganism up to 50c⁰.
- The segmentation of the reactor zone, variation of packing densities can offer some solutions.



In our next issue:
Cell & tissue culture media

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