FERMATEC

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Development of a Biotechnological High Yield Process for Ethanol Production, based on a Continuous Fermentation Reactor

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BIO-ENERGY
ENLARGED PERSPECTIVES

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•Novelty of FERMATEC Project

•Introduction of continuous fermentation.

This is the tendency in big companies, dealing with greater and greater production rates.

•Use of fluidised systems.

This system is adapted to well known characteristics of liquids to ferment: high viscosity, suspended solids, need for agitation. Is then possible to avoid the consequent problems without great need of sophisticated devices.

•High concentration of micro-organisms by immobilization.

The use of suitable solid matrix carefully selected for immobilization, and simultaneous possible fluidisation is one of the innovations of FERMATEC. Once attained this objective, we can expect great productivity of ethanol, and consequent considerable reduction of reactor volumes.

•Selection of more stable and more productive micro-organisms.

The use of alternative micro-organisms in fermentation can lead to higher yields, higher conversions and best kinetics.

•Possible fermentation of different sugars.

Preliminary studies show that some of the micro-organisms that are going to be tested can ferment marginal or alternative sugars, including pentoses.

• Lower ethanol loss.

The use of controlled and closed fermenters, coupled to devices prepared for condensation and washing of gases will recover the totality of the evaporated ethanol.

•Efficient control of process.

The use of continuous process is best controlled and monitored by software and hardware. Any small change and tendency alteration of controllable parameters is instantaneous detected.

•Less space occupation and fermenters volume.

The use of the combined efficiency of best adapted micro-organisms and intensification of concentration of biomass will give optimised kinetics and in consequence, lower fermenter volumes.

•Less energy and man work.

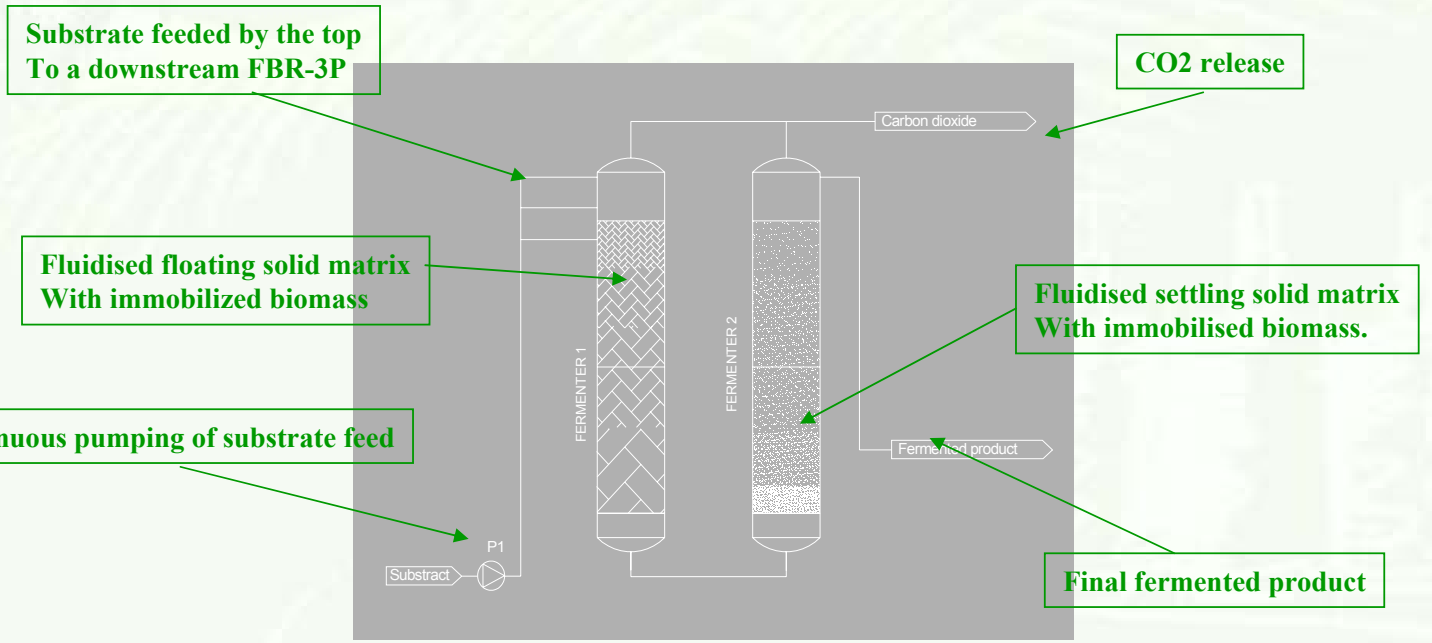
The use of fluidised fermenters increase the interior backflow and agitation, thus being not needed mechanical agitation of liquid.
The man work, usually high in batch processes, is in this case very low.

•Sub-products recovery.

The use of continuous closed fermenters, will allow the recovery of CO_2 produced.

• The design behind FERMATEC Bioreactors

Fig. 1- *FBR-3P: Downflow and upflow in sequence FERMATEC*

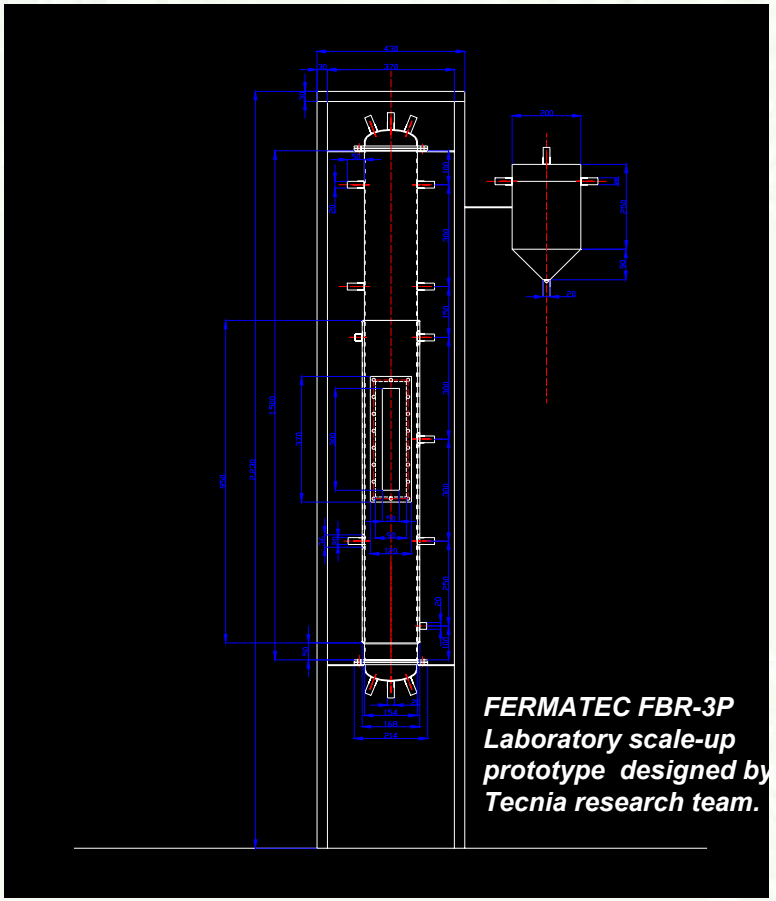


The fermentation reaction, in its high rate is characterised by a strong agitation originated by carbon dioxide release. The usage of a down-flow FBR-3P has the advantage of avoiding the solid matrix and biomass washout, due to the up-flow carbon dioxide bubbles.

For each fermenter research is in progress to select the best solid support to be used, in face to the microorganism selected.

The use of different microorganisms in each fermenter is in accordance with the fact that best rates of conversion in the first fermenter can be conjugated with good yield (finishing) in the second fermenter.

• FERMATEC first prototypes



FERMATEC FBR-3P Laboratory scale-up prototype designed by Tecnia research team.

FERMATEC FBR-3P Laboratory scale-up prototype build by Tecnia workshop.

• FERMATEC Objectives and actual progress

	TRADITIONAL	FERMATEC	Actual FERMATEC Progresses
Equipment	Batch tanks	Continuous immobilized biomass and fluidised bed	Two FBR Prototypes
Human labour	Required each time the batch process is initialised and finished	Continuous operation Less Human Labour	Confirmed
Energy	Required agitation	Agitation promoted by inflow feed Less energy required	Good possibility
Productivity	Standard batch fermentation = 1,8 to 2,5 g Ethanol/L.h.	Productivity above 25 g Ethanol/L.h.	Laboratorial tests > 25 g/Ethanol / L.h
Process looses	2-5% (alcohol evaporation)	No process looses (evaporated alcohol can be recovered to the process by continuous condensation).	Good possibility
Micro-organisms	Used large amounts of yeasts (not recovered).	Yeasts and other micro-organisms can be immobilized much less consumption.	Sacaromices Cerevisae, Zimomonas Mobilis Bacilus Sp.
Control	Very difficult to implement.	Total control of the main parameters in fermentation process	Good possibility
Operation	Batch time : Very High (2-3 days)	Continuous (Hydraulic residence < 8 hrs)	Needs complete prototype-industrial tests
Sub-products	Total lost of sub-products	CO_2 can be recovered, stored and commercialised as raw material for several industries.	Good possibility

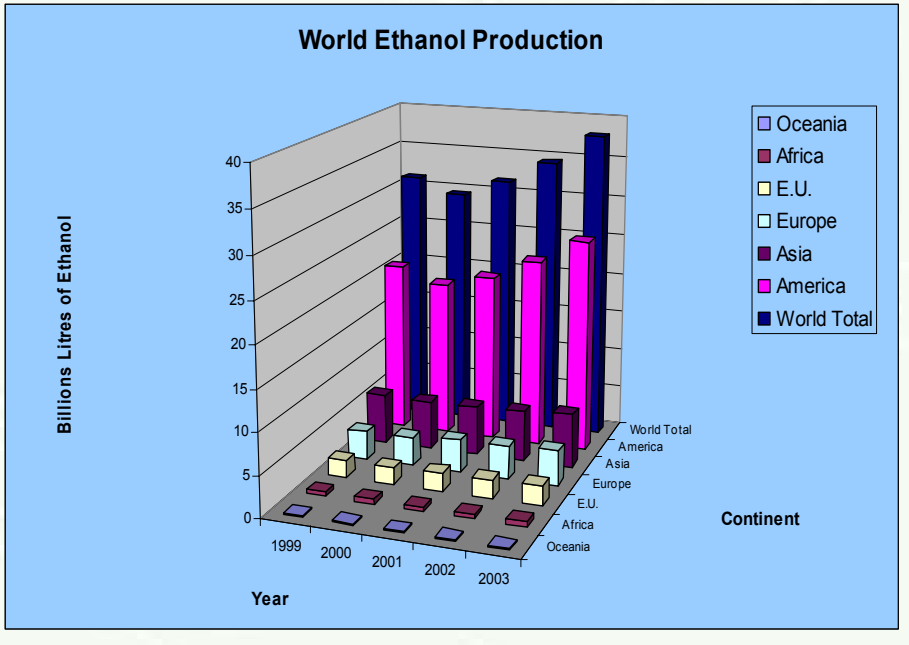
• FERMATEC accordance with European Commission Directives and World Ethanol Production

• → The European Commission has taken certain decisions which will impact the Community´s Ethanol Industry both directly and indirectly:

❑ The legislation will go a long way towards forcing Member States to acquaint themselves with the matter of biofuels;

❑ The law (May 2003) provides for indicative targets of a 5,75% biofuel content in all fuels by December 31, 2010, starting at 2% by December 31, 2005;

Total ethanol use by 2010 could reach some 11 bln litres a year if all EU-15 Member States comply fully with fuel for transports legislation; this compares with an estimated 390 mln litres in 2003!!!....



FERMATEC advantages

- A cost effective process for continuous bio-ethanol production.
- Reduce ethanol production cost in a minimum of 20%.
- Increase bio-ethanol production yield up to 25 g EtOH/l.h.
- Provide a modular fermentation unit able to be integrated in existing distilleries.
- Improving environmental quality, reducing oil dependence and using natural renewable resources.

Immediate future : (one and half year).

-Operation of laboratory prototypes.
-Develop, design and build of a large semi-industrial prototype.
-Long test runs and trials.
-First Commercial FERMATEC bioreactors.