



## SUMMARY OF RESULTS TO DATE AND PERSPECTIVES

### The project proposed concept

This research project aims a totally integrated bioethanol production process, in order to improve the productivity of existing ethanol generation (sugarcane molasse fermentation), the so-called First Generation Bioethanol, to develop suitable processes for improving the Second Generation Bioethanol (from biomasses) and to investigate the viability of the Third Generation Bioethanol, which is produced from algal/bagasse biomass or from catalytical or biological fermentation of synthesis gas. The Third Generation Bioethanol has a major appeal of consuming carbon dioxide produced in the First and Second Generation processes, causing the great impact of almost zero CO<sub>2</sub> emission within the whole integrated process. The improvement of the energy intensive processes that constitute the distillation units are also objective of study in the present project and the proposal of alternatives procedures will be evaluated, including the hybrid configurations. *Figure 1* depicts a schematic diagram of the integrated process for bioethanol production.

### Justification expected results

The interest in biotechnology-based production of fuels tends to increase with the concern about exhaustion of fossil fuels and the increase in their price. The world meetings make clear that policies for renewable energy are essential to achieve sustainable development in a broad sense. Environmental protection, job creation, alleviation of external debts in developing countries and security of supply are some of the key issues to mention. In Brazil, the sugarcane industry keeps the greatest commercial energy production in the world with bioethanol and the almost complete use of sugarcane bagasse as fuel. In addition to growing sugarcane and processing it to produce bioethanol and electricity, new biorefineries in Brazil should focus on marketing conventional bioethanol, its associated agricultural assets and co-generation plants, as well as making use of the acquired data and experience to contribute to research aimed at developing next generation biofuels. Thus, it is essential to implement a research program for the integrated production of bioethanol, where studies will be focused on improving the first generation bioethanol, the bioethanol from lignocellulosic feedstocks (second generation bioethanol) and mixed alcohols produced from synthesis gas, Substitute Natural Gas (SNG), and H<sub>2</sub> (third generation bioethanol). Although first-generation biofuels have the potential to replace fossil fuels as the main source of energy supply, its production is surrounded by issues like effects on global food supply and tropical forests destruction. Instead, second and third generation bioethanol offers the advantage of disconnecting the biomass from the food supply. These approaches have a better lifecycle and carbon footprint than sugarcane bioethanol. However, there are challenges and obstacles such as cost, technology and environmental issues that need to be overcome. Hence, the introduction of new processing integrated technologies is crucial in promoting and implementing bioethanol effectively and subsequently turning it in an environmentally, as well as economically, feasible source of energy.

Rubens Maciel Filho

Faculdade de Engenharia Química  
Universidade Estadual de Campinas (UNICAMP)  
Departamento de Processos Químicos  
Caixa Postal 6066  
CEP 13081-970 – Campinas, SP – Brasil

+55-19-3521-3958  
maciel@fea.unicamp.br