

1. Potential Benefits from IPR for Rapid Fermentation for Ethanol.

1. Product self-cost decrease which gives more flexibility and marketing advantages.
2. CO2 credits.

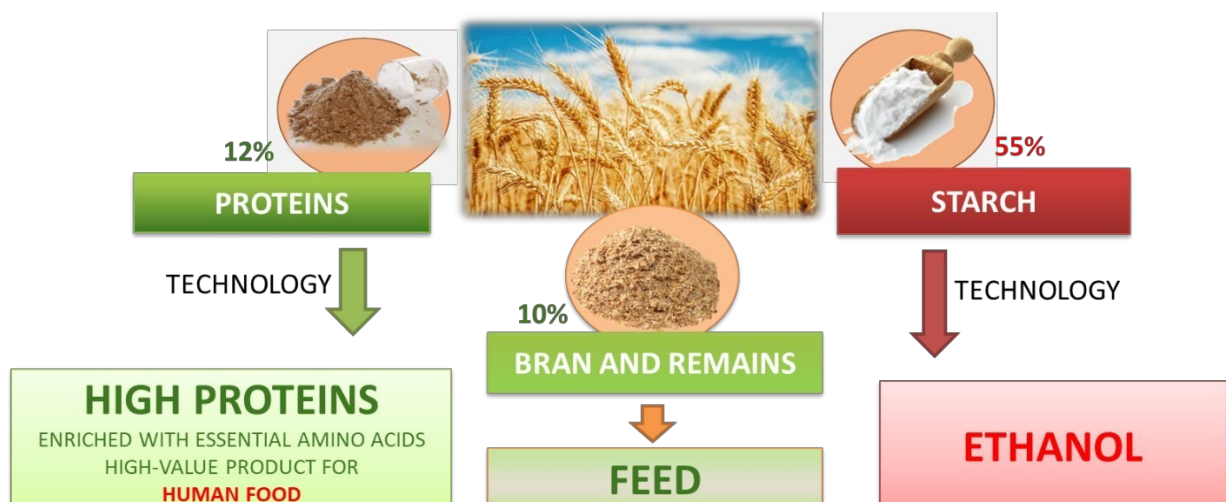
2. Proposed Ethanol IPR competitive advantage.

Traditional conversion of wholly crushed grain into ethanol is an energy-intensive process, which also generates significant gas emissions, as well as liquid and solid waste.

Based on the previous BioChemTec' (BCT) experience on the Continuous-Flow-Fermentation by Cell Recycle Membrane Technology (CF-CRMT-Fermentation) worked-out system it can be declared that brewing of the different saccharide substances up to several end products can be done more effective way than current general technologies allow.

Namely, it is possible to ferment ethanol on the basis of technology, which **increases the speed of the process up to ten times**, which in turn allows the process to be built as a continuous flow process and up to 70 % reduce the investment and energy costs of the process based on BCT pilot-scale experimental results.

The process is based on the grain components (starch/sugar and protein) separation with latter continuous-flow sugar fermentation and tangential filtration of the brewed slurry. The proteins compose a significant additional revenue flow, making the method economically viable and robust. BCT cereals processing method create two high value products: fuel additives (ethanol) and high value proteins, which increases the added value of the consolidated production and enables the ethanol costs decrease. Alternative proteins production is in the up-trend and one of the Major food manufacturers have to be involved in the high-value proteins production.



At the same time, the **CO₂ emission of the process can be reduced by 336 kg for each ton of ethanol** which is an important benefit, especially in the future strengthening carbon footprint measures.

Table. CO₂ savings by BCT Continuous-Flow- CRMT-Fermentation
Inputs per 1000 L 98% ethanol produced from the corn.

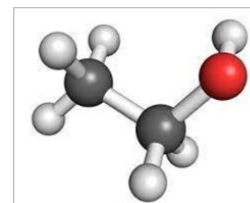
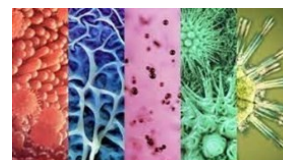
Inputs	Units	Standard Fermentation	BCT CF-CRMT-Fermentation	CO ₂ savings by BCT, kg
Grain	kg	2 690	2 690	
Transport	kg	2 690	2 690	
Water	L	15 000	10 500	58,500
Stainless steel	kg	3,0	2,1	0,029
Steel	kg	4,0	2,8	0,468
Cement	kg	8,0	5,6	2,160
Steam	kcal	2 546 000	2 259 575	266,440
Electricity	kWh	392	382	8,379
EtOH concentration	kcal/L	9	9	
Sewage effluent	kg BOD	20	20	
Distribution	kcal/L	331	331	
Total CO₂ savings				336 kg

3. IPR development program

The IPR creation program should include Ethanol Technology development up to FEED Engineering:

- Technology integration to present market and stakeholder's situation
- Preparation of microbiological material for an active cycle,
- Patenting activities
- Large-scale Pilot test for engineering design inputs
- Front End Engineering & Design

BioChemTec would be very interested in contributing to the future technologies' development and deployment, utilizing its own comprehensive experience, knowledge, and potential. There are multiple capable service suppliers, and BioChemTec team would be very appreciated to be chosen as one of the contributors to these technologies' attractiveness evaluation and consequent development.



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