

The final goal of COMETHA is the construction and operation of an integrated pre-commercial industrial second generation cellulosic bioethanol plant.

During the first period, the consortium has worked to achieve the following major goals:

- definition of the feasibility and permitting procedure;
- evaluation of the performances of the main sections of demo plant and of the possibilities for their scale up;
- selection and development of high performance enzyme cocktail;
- definition of the basis for obtaining an integrated assessment for the process;
- elaboration of dissemination activities concerning the project.

## Performances and scale up possibilities of the main sections for the pre-commercial plant

The main sections of the demo plant are:

- pretreatment;
- viscosity reduction/enzymatic hydrolysis;
- co-fermentation;

their performance has been investigated in order to find the best engineering solution for the precommercial plant construction

The flexibility of the pretreatment technology to different biomasses was demonstrated, also thanks to an extensive work of testing of new biomass at pilot and demo scale. Process stability was demonstrated both for *Arundo donax* and wheat straw. The material exiting this section was also analyzed for subsequent hydrolysis with enzymes.

The optimization and process stability of the whole section were also increased. Scale up choices for this section will likely be a single reactor for viscosity reduction, using the residence time validated through the operation of the demo plant in Crescentino.

## Development of high performance cocktail of enzymes

One of the objective of COMETHA is to develop a cocktail of enzymes optimized to work under the conditions of the PROESA® technology. Novozymes is developing new and more efficient enzymes compared to current benchmark enzymes. This will be achieved by focusing specifically on the needs of the 2nd generation technology and the feedstock to be used.

A screening and process optimization effort was undertaken to identify individual enzyme molecules with superior performance under the conditions imposed by the technology.

In 2016 a new enzyme formulation has been tested. In term of process parameters, an optimal equilibrium between enzyme dosages, level of solid concentration in the hydrolysis tank and hydrolysis residence time has been determined.

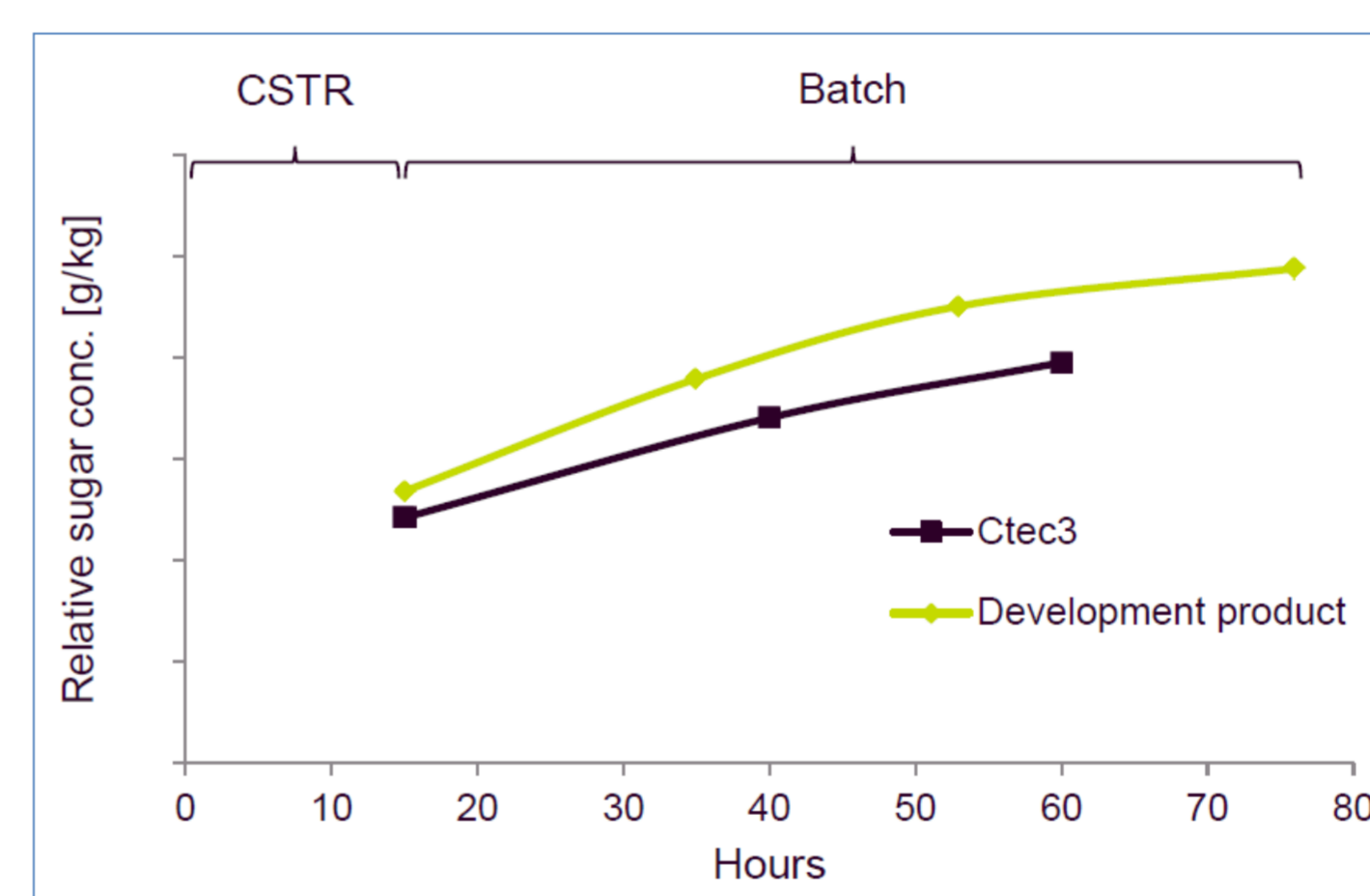
Novozymes's strong enzyme discovery platform will be used to identify improvements, largely based on information from the Crescentino facility. New leads will be tested in continuous operation at pilot scale to verify scalability. Cost reduction will be achieved by:

- incorporation of improved molecules
- incorporation of novel molecules
- optimised use of the enzymes
- combination of the above

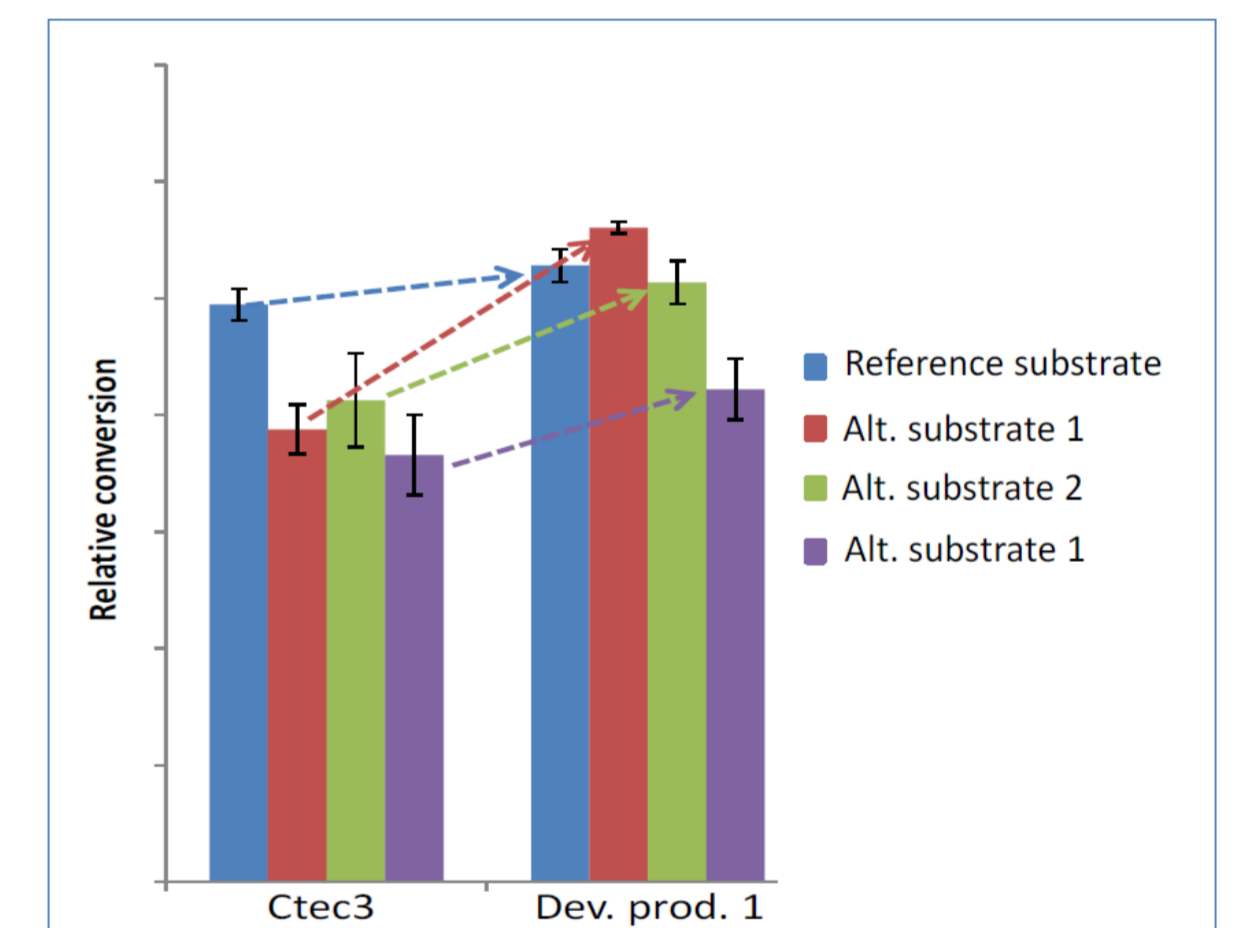
## Sampling of enzymes for pilot testing and development products

Novozymes has produced and sampled 9 different development cocktails for batch and continuous hydrolysis at pilot scale since project start-up

- Development product performance was verified in CSTR+Batch trials in Rivalta pilot plant



Conversion in performance evaluation of Ctec3 and new enzyme cocktail on four differently pretreated materials.



Hydrolysis performance of the new enzyme cocktail and benchmark enzyme in the pilot plant

## RESULTS

Improved performance of the new development products was demonstrated, when compared to benchmark product, Cellic® Ctec3, at comparable doses.

The results highlight the importance of an iterative pretreatment and enzyme development where any changes in pretreatment are considered in enzyme development and pretreatment development accounts for what gives the best potential for further enzyme development.

## Partners



Project coordination construction and start-up of the biorefinery, management of the biomass supply chain



Environmental assessment and policy-making component.



Viscosity reduction, commercial-scale enzymatic hydrolysis processes development of enzyme cocktail.



Communication and dissemination of results.