34th VH Yeast Conference

Advances in Science & Industrial Production of Baker's Yeast

Vienna - May 15-16, 2023

"Zero waste and circular (yeast) production"

in cooperation with

Invitation

We kindly invite you to participate in our 34th VH Yeast Conference 2023, with focus on “Zero waste and circular (yeast) production”. The yeast industry, yeast technologists and suppliers are challenged by energy system and regulatory demands (EC Green Deal) for greenhouse gas reductions and circular production concepts. Our lecturers will share their considerations and experiences with you.

We look forward to a lively exchange and a great networking event!

M. Eng. Sc. Antoine Chagnon, President of VH Berlin
Dr.-Ing. Michael Quantz, General manager of VH Berlin

Conference day I, all times in CEST = UTC +2h

Monday, May 15, 2023

10:15 a.m. Conference opening and welcome

President A. Chagnon

Lallemand Inc. (CAN)

Markets

10:30 a.m. Latest development and concepts to decarbonise the food industry

Sébastien Schellen

De Smet Engineers & Contractors (BEL)

Biomass-based energy (solid fuel or biogas) and green electricity take a growing share in today’s low-carbon/carbon-free energy sources.

Contrary to industries with high temperature energy consumption (e.g. steel or cement industries), food industries use relatively low temperature energy. In order to reach low-carbon/carbon-free reduction objectives, imposed by climate emergency and worldwide regulations, the food, and also the baker’s yeast industry will have to re-design sooner or later its complete energetic scheme. Which energy source for which purposes? Electricity? Biomass? Hydrogen?

The presentation reviews the panorama of solutions answering to the aforementioned questions.

Among these solutions, the optimization of the process by using current well-known technologies is a 1st option: heat integration between upstream and downstream operations, mechanical vapor re-compressors (MVR) implementation, heat pumps installation, various cogeneration technologies, by-products methanisation, etc.

Combining these solutions will support the food industry to decrease significantly their specific energy consumption and provide some solution to improve its carbon footprint.

11:00 a.m. CarbonMinds: Yeast Factories and the Carbon Footprint of Ammonia-Starch and Urea: Understanding the Environmental Impact of Biomass Production in Europe

Francesco Scalogna

Carbon Minds (GER)

The yeast factories in Europe are the largest biomass producers, producing about 1 million tons of biomass. In the yeast industry, ammonia-starch and urea are important N-suppliers, which are important for growth/protein/enzyme synthesis. As product carbon footprints (PCF)s are on everyone's lips, what does PCF of these two basic chemicals look like before being further processed by the yeast industry? Where can you find information on PCFs in the chemical industry? How do different energy sources (renewable, conventional) influence the PCF?

Using the example of a cradle-to-gate life cycle assessment model for urea, including the production of raw materials to the production of urea, the above questions shall be addressed.

11:30 a.m. Brief Coffee Break

12:00 p.m. Breweries and their sustainability potential

Bettina Muster

AEE INTEC (AUT)

In recent years, breweries have often been pioneers in terms of conscious use of resources and renewable energy. The traditional brewery has long worked with heat recovery, energy storage and brewing water management in combination with quality-conscious production, but the idea of deepening this path towards the "green brewery" was nevertheless a pioneering one in the early 2000s.

Energy efficiency measures, such as reduction of the evaporation rate during wort boiling, new energy swings between energy storage and mash heating, or even continuous brewing processes have only been able to establish themselves successfully in recent years.

The current discussion of the "circular economy" fits perfectly into the thinking of brewing companies - from high-quality grain via hops and malt and crystal-clear water to beer, if possible without residual materials - is an ideal state of affairs that other production companies can only dream of. With new ways of thinking about using spent grains not only as feed but also for energy and making the fermentation residues available to agriculture, breweries are now taking a further step, namely linking the provision of resources and energy. This combination will be an important asset for many bio refineries in the future.

Analytics and Quality

12:30 p.m. Increasing yeast cells' metabolite formation by separation according to their cell age

Marco Eigenfeld

Technical University of Munich (GER)

In the industrial environment, yeasts are exposed to multiple simultaneous stressors (high sugar concentrations, inhomogeneity, salt, pH value, O2 content, ethanol, and metabolites), influencing the physiological state of the yeast culture.

As a result, the yeast population adapts to their environment, resulting in altered fermentation performance, energy metabolism, aggregation behavior, and aroma profile. Therefore, the fermentation process essentially depends on the sum of the physiological states of the individual cell. Nevertheless, the singular yeast cells differ in their phenotype; the individual cell age is an important factor. To ensure a consistent quality of the product, knowledge about the age distribution in yeast cultures and an understanding of age-dependent energy metabolism are essential.

This presentation will indicate the interconnection between the singular cell age and their age-dependent energy metabolism. Furthermore, we will demonstrate the impact of age distribution on biomass formation and fermentation speed.

01:00 p.m. Conference Lunch Break

Circular Production

02:15 p.m. Sustainable Effluent Management System for Yeast Manufacturing

Asif Chiplunkar

Oriental Yeast India (IND)

We are an 100% Japanese company with an investment of around 105 Mn USD in India, set up the factory for manufacturing of Baker's Yeast 33,000 Mt/Anum.

We have set up a Zero Liquid Discharge (ZLD) Effluent Treatment Plant, and all treated effluent is recycled for Cooling Tower Make-up, Boiler Feed Water, Gardening. Around 22 Mn USD invested for Environment Protection System.

This effluent treatment process has Segregation into High COD & Low COD Effluent treatment. High COD treatment consist of Concentration through evaporation system, Concentrate incineration, Condensate treatment by Anerobic Biological System & membrane System. Low COD Effluent treated by Chemical method and followed by membrane system.

Domestic Effluent is treated separately in Sewage Treatment Plant and treated water is used for gardening.

Incineration Boiler for concentrated effluent is a unique boiler which is specially designed for Yeast Plant effluent. This boiler incinerates effluent and steam generated is supplied to Yeast Plant.

This plant operates with Co-Gen Power and installed capacity is 4.67 MW.

02:45 p.m. Circular nutrient recovery from wastewater with microalgae

Alexander Piek

GEA Westfalia Separator (GER)

The SABANA project (Sustainable Algae Biorefinery for Agriculture aNd Aquaculture) aimed a development and large scale demonstration of a microalgae-based biorefinery achieving a zero-waste process to produce biofertilizers and aquafeed. Fresh water or marine water microalgae species were cultivated in demonstration scales up to 5 ha open-pond bioreactors with nutrients from wastewaters like sewage, centrate or pig manure. The target products were the biomass itself to produce mainly hydrolyzed biomass as a biofertilizer for agricultural products or disrupted and dried biomass as a aquafeed ingredient to replace grain ingredients partly or as a whole from formulations.

Main objectives in the whole project were:

(i) the utilization of microalgae-bacteria consortia and in co-culture with other algae to control grazing species

(ii) the implementation of efficient thin-layer cascade and raceway

(iii) the scale-up of reactors to ensure stable operation

(iv) to use marine water to increase the sustainability of the process

(v) to recover nutrients from wastewaters

(vi) to develop harvesting processes taking into account the remaining water

(vii) to establish processes for mild/energy efficient extraction of bioproducts

(viii) to process residual biomass to produce biofertilizers and aquafeed in zero-waste schemes

(ix) using robust and sustainable technology

GEA Westfalia Separator was mainly involved in objectives (vi) and (vii) and equipped 3 demonstration facilities (R&D-, PILOT- and PRODUCTION-scale) for the biomass downstream process with its technologies for biomass harvesting and concentration with a disc stack separator or decanter, cell disruption with a high pressure homogenizer and spray drying (R&D scale).

During the presentation the process schemes and technology implementation will be highlighted. It can be discussed if similar process schemes can be applied to wastewater streams from the yeast industry.

03:15 p.m. Coffee Break

Presentations from the industry

03:45 p.m. The future of flexible process control at the example of the food and beverage industry

Andreas Zintel & Dirk Grafe

Siemens AG (GER)

The digital transformation is changing the way how food & beverages are produced today and in future. New consumer trends, technologies and innovations are increasing the complexity of operation tremendously. At the same time there is a huge demand to increase productivity and efficiency of the production processes and a scarcity of qualified and experienced talents.

To address these challenges, manufacturing companies must focus on standardized systems, helping them to simplify the control of their production processes, to manage operational complexity, connect with other systems and provide a maximum of transparency.

SISTAR® process automation system is the first choice for process automation at facilities of all sizes in the food and beverage industry. It is economical, easy to operate, seamlessly scalable, extremely stable in operation, and delivers precise results.

In this session we will present why SISTAR fits perfectly to the demands of the yeast industry fulfilling its needs with among others state-of-the-art recipe control, IT/OT integration, modular automation concepts as well as web-based features like track & trace of materials.

Visit & Convivial evening

04:30 p.m. Bus transfer to *Ottakringer Brewery*

04:45 p.m. Visit *Ottakringer Brewery*

06:30 p.m. Convivial evening at *Ottakringer Brewery Hopfenboden*

In addition to a dinner event we will enjoy many networking opportunities.

https://www.ottakringerbrauerei.at/en/location/hopfenboden/

10:30 p.m. Last transfer back to the hotel / End of conference Day 1

Conference day II, all times in CEST = UTC +2h

Tuesday, May 16, 2023

Applied research

09:00 a.m. Development, Manufacturing and Fermentation Performance of Novel Hybrid Yeast Strains in Industrial Ethanol Fermentations

Peter Krasucki

BGW (POL)

Ethanol fermentation processes are functionally dependent on biocatalytic activity of living microorganism, *Saccharomyces cerevisiae* (yeast). Development of novel stable yeast strains with stable genotypes, resistant to stress and sometimes possessing additional metabolic activities beside central metabolism pathways involved in ethanol metabolism bring additional benefits when employed in the industrial setting.

Critically, genetically stable yeast strains with improved tolerances to the industrially relevant stress factors allow for yeast recycling without compromising their metabolic capabilities. While in some processes use of genetically modified organisms is permitted, significant need remains for implementing non-genetically modified microorganisms.

Implementation of common classical hybridization methods with robust screening allows for selection of hybrids with targeted phenotypes. When combined with genotyping strain differences can be further characterized and leverage during development and production.

To obtain new families of strains the classical hybridizations methods such as: direct mating, rare mating, and mass mating were used. Combining these hybridization methods with targeted stress focused hybrid screening allowed for selection of hybrids with improve ethanol performance characteristics vs. parental strains. In our case we have obtained genetically stable yeast strains allowing for yeast recycling, improved stress tolerance strains as well as strains with extracellular enzymatic activity.

09:30 a.m. Systematic study of branched-chain amino acids and carbon metabolism crosstalk in yeast

Ximena Escalera Fanjul

Humboldt University Berlin (GER)

Saccharomyces cerevisiae is widely used for fundamental biology and as a cell factory. Its unique fermeto-respiratory metabolism has long been subject of study and its ability to ferment sugars to ethanol under aerobic conditions has been exploited for a long time. It is well establish that during fermentation, the energy for yeast growth is mainly provided by an accelerated glycolytic flux and most of the carbon skeleton for biomass production are provided by an attenuated TCA cycle. When glucose becomes limiting, cells undergo a so-called diauxic shift, a transient phase in which they switch to a fully respiratory metabolism, in which energy and biomass are manly produce by TCA cycle. To make yeast more efficient cell factories we most understand how energy and biomass-providing pathways are orchestrated.

We used the Branched Chain Amino Acids (BCAAs) pathway to study the dynamics of the energy-biomass interphase in yeast, while shading light on the industrial relevant fusel alcohol providing pathways. We generated a collection of knockout (ko) strains, in which we deleted or modified the strength of each negative feedback loop of the BCAAs pathway without disrupting the biosynthesis of BCAAs. Wild type and ko strains were used to asses the protein profile of the pathway during the diauxic shift by high-throughput flow cytometry; and for LC/MS metabolomic measurements to asses the metabolic profile of the pathway and other key metabolites involved in energy and biomass-providing pathways. The experimental data was used to develop a computational metabolic model that allowed us to understand the dynamics of this system. Results obtained with this combined approach show that leucine and valine biosynthetic pathways display opposed responses over the diauxic shift and only some key elements regulate the overall pathway response upon environmental or genetic perturbations.

10:00 a.m. Bioprocess development for the production of polyphosphate-rich yeast extract as a novel food additive

Alexander Deitert

RWTH Aachen University (GER)

Phosphate is an essential resource required to meet the food demand of the growing world population. However, the reserves in form of phosphate rock will be depleted soon which urges a transformation to a circular phosphate economy.

The baker's yeast *Saccharomyces cerevisiae* is able to accumulate phosphate in form of long-chain polyphosphates (polyP) in high cellular concentrations. In biological systems, polyP can reach chain lengths up to 1,000 subunits. This and the use of various impure phosphate sources are advantageous in comparison to polyP originating from chemical production with chain lengths limited to 40 subunits at a large scale. PolyP has adjustable physicochemical properties defined by the chain length and the counter-ion, thereby adding value compared to monophosphate. Next to various innovative applications of polyP with tailored physicochemical properties, polyP-enriched yeast extract can be produced, serving as a novel food additive.

Previously, we established a proof-of-concept for polyP production and developed adjacent analytics for total polyP content as well as average chain length. The transfer of the decoupled production in shake flasks to a one-pot fed-batch cultivation in a stirred-tank reactor has successfully been achieved and will be further optimized. Subsequent downstream processing is currently developed.

Moreover, a high-throughput screening methodology for highly productive native yeasts strains, such as baker's or brewer's yeasts, and genetically modified strains, is currently developed. In this context, an extraction procedure was developed and the cultivation conditions are further adapted to fit the requirements of an effective and robust high-throughput screening process. Applying this methodology to yeast strain collections will identify novel hyperproducers. In combination, all strategies will enable effective high-titer production of polyP in *Saccharomyces cerevisiae* at an industrial scale in the near future.

Poster session / presentations from the industry

10:30 a.m. New real-time analysis method for dry yeast and yeast suspension (NIR)

Alexander Mücke

fzmb GmbH (GER)

Ash2Phos - Implementation of high-grade P recovery (update)

Christian Kabbe

EasyMining Germany (GER)

van Mourik Yeast & Packagaging:
Yeast Downstream Equipment & Automation

see documents provided in the conference folder

van Mourik Yeast & Packaging (NED)

10:45 p.m. Coffee Break

Process units

11:00 a.m. Process-driven improvements of yeast stability and shelf life

Ugur Postalli (TUR)

Yeast metabolism has 2 different metabolic pathways to be alive depends on oxygen presence in medium.

- In the presence of air, the yeast multiply by the glucose respiration. Yeast produces CO_2, H_2O and energy by the oxidation of glucose.
- In the absence of air, the yeast multiply by the glucose fermentation. Yeast produces EtOH, CO_2, aromas and energy by enzymatic pathway.

In two pathways, we prefer to apply glucose respiration in the presence of air for bakery yeast production. Because, we need to produce yeast for bakery applications.

In yeast production, applied fermentation pattern is important to determine growth rate which defines the productivity and quality, EtOH level during fermentation is to show how we apply and manage defined growth rate. Also, EtOH presence at the end of the fermentation can affect stability. Because yeast will continue to multiply.

And yeast stocks hydrocarbon as glycogen and trehalose which are important for yeast. By the oxidation of glucose, energy comes out during fermentation as increasing temperature. So, temperature regulation is key important because yeast activity is changing according to temperature during fermentation and to manage CH stocks for stability.

In order to stop fermentation, we separate yeast which is called cream yeast, from fermentation medium. By this application and washing, we take out all of residual materials which is outside of the yeast cells and affect the quality and coming from molasses. Dry matter of cream yeast is around 20%.

In order to increase DM to about 30-35%, needs to remove extra-cellular water. The salt addition permit to remove more easily the water inside the yeast cells to increase the dry solids from the yeast cells and to obtain a non-sticky product by the increased osmotic pressure. These foreign partials are bad for the odor and the conservation of the yeast. Higher residual salt content acts as a yeast inhibitor. That's why, targeted conductivity should be below 500 µS for better stability.

By the applying non washing separation can be saved time, almost 60% energy (2 times less separation) and no water consumption to protect environment. Also salt consumption will be less than washing separation applications.

We can produce tailored yeast depends on bakery needs which are normal, high speed, very high speed or sweet or propionate adapted yeast. Yeast activity which is mean raising power determined by the applied fermentation pattern. Storage CH (glycogen and trehalose) allows to determine stability which is shelf life and conservation. Shelf life determined by the amount of storage CH and partially yeast activity and storage temperature. That's why shelf life of the yeast which has high raising power is shorter than normal.

11:30 a.m. The use of soybean waste as a basic source of nitrogen for the production of baker's yeast and the evaluation of its activity performance

Mohsen Parhizkar

Razavi yeast Co. (IRI)

The yeast industry in the world is one of the leading industries in meeting the needs of human life. Due to the outstanding and unique characteristics of different types of yeast being used in the world, there is a need to reduce the amount of waste in the production lines and its waste to zero.

In this research, by using the high wastes of soybean meal production factories in Iran, it was tried to save all the wastes of that factory in the production line of Razavi yeast co. after purification, refining and using its basic nitrogen elements in the production line. Urea should be prevented due to its increasing price.

In this research, using preparation treatments in the upstream process of yeast production and after defining the main parameters in the production batches, it was used. Its effect is on the quality factors of baker's yeast or the activity parameter of baker's yeast. In this research, using acid hydrolysis of soybean waste, after hydrolysis of soybeans with 1-7 normal hydrochloric acid and temperature of 35-55 degrees Celsius and the duration of hydrolysis, the resulting suspension was purified and soybean syrup was obtained. 10 treatments based on levels

The different combinations of urea nitrogen sources and hydrolyzed soybean syrup were determined using the Box-Wilson statistical method, and the treatments were tested and evaluated in the laboratory fermenter. Based on the activity parameter, it was determined that the ratio of urea nitrogen sources and hydrolyzed soybean syrup to the amount of 40% hydrolyzed soybean syrup and 60% urea was determined.

Process units

12:00 p.m. Razavi yeast plant expansion: advanced fermenter design

Abolhassan Vaziri

Pars Lysine Co. (IRI)

The objective of Razavi yeast Co. is to expand its production capacity by several times through some expansion projects, including fermentation, upstream, and downstream processes. The investigation of the current plant situation has shown

that repeating the existing 150m^3 fermenters is impossible due to room restrictions for equipment allocation, leading us to use some 350m^3 fermenters instead. However, due to other plant conditions, the size reduction of one of the fermenters to 258m^3 was necessary. The project scope of work comprised molasses preparation and sedimentation tanks, yeast cream storage tanks, the fermenter and its feed tanks, acidification tanks, and CIP tanks. The fermenter was designed based on aeration through sparger. Still, according to the client's will, the possibility of installation of a Dynamic Aeration System (TRG) has been foreseen in the design and construction.

As the fermenter design is based on actual operation experience with several fermentation technologies, the construction cost has been considerably decreased, moreover, the advantages of the installed 258m^3 fermenter comprises of better cleaning efficiency, sustainable higher quality, lower raw material consumption and lower energy consumption per product unit weight, while due to improved design considerations, cleaning time has been decreased and regarding the fact that the fermenter is not contaminated as the result of improved cleaning performance, longer comprehensive cleaning intervals has been achieved.

Furthermore, thanks to the comprehensive philosophy of control, comparing the actual data from the new 258m^3 fermenter with previous 150m^3 fermenters using TRG and sparger have shown a significant improvement in total yield (10%), yield per raw material consumption (5%) and product activity (12%).

12:30 p.m. Feedback & Farewell

President A. Chagnon

Lallemand Inc. (CAN)

12:45 p.m. Conference Lunch

02:00 p.m. End of conference