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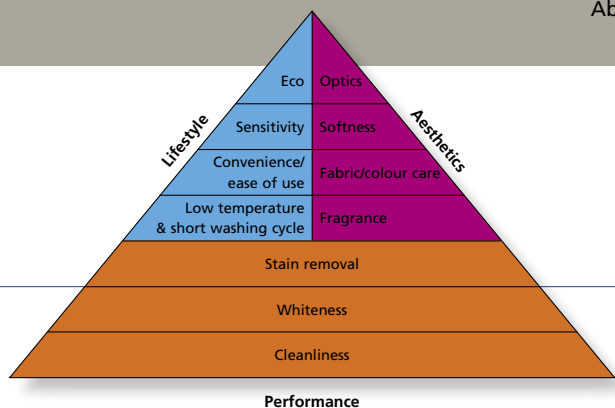


novozymes 

Unlocking the magic of nature

Novozymes is the biotech-based world leader in enzymes and microorganisms. Using nature's own technologies, we continuously expand the frontiers of biological solutions to improve industrial performance everywhere.

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JOIN THE INDUSTRIAL EVOLUTION

Washing cleaner and 'greener'

The third in a series of short articles about how biological solutions have driven the evolution of industry forwards.

Most people are familiar with the use of enzymes in detergents but are not aware that enzymes have revolutionised the formulation of detergents as well as wash habits over the last few decades.

It all began with the ability to break down stubborn protein stains that previously could only be removed by scrubbing, boiling and using harsh chemicals. Novozymes' intro-

duction of the efficient detergent protease Alcalase® in 1963 was the start of a revolution in cleaning. It enabled tough stains to be tackled without damaging the fabric. Today, clothes are often washed clean at temperatures as low as 30-40°C.

Since the introduction of Alcalase, there has been a steady stream of technological breakthroughs in enzymatic cleaning. New types of enzyme designed to remove different types of stain and to care for fabric have become widely used in the market.

And the use of enzymes has expanded far beyond stain removal. Specialised enzymes can make colours brighter, improve whitening, and make fabrics feel softer. These unique characteristics make enzymes one of the primary ingredients supporting many of the advertising claims for today's laundry detergents.

Furthermore, enzymes have helped to make detergents more environmentally friendly by reducing consumption of water and energy as well as the quantity of chemicals required to get clothes clean. The latest enzymes such as Novozymes' Polarzyme® and Stainzyme® have made it possible to wash effectively in cold water conditions, which is an increasingly common preference for consumers.

The most common classes of enzyme and their use in detergents are outlined in the table. Today, the majority of detergents worldwide contain enzymes, with some detergent brands containing up to five different types in order to obtain a broad spectrum of cleaning and fabric care benefits. The detergent industry is constantly looking to Novozymes for new developments in enzymes. ●

Proteases	Fight stubborn protein stains such as blood, grass, etc., and can operate at wash temperatures as low as 5°C.
Amylases	Remove residues of starchy foods such as mashed potatoes, baby food, ready-cooked meals and gravy.
Cellulases	Offer benefits such as colour brightening, whitening, softening and fabric care. Cellulases are capable of removing fuzz and pills from cotton fabrics, making them look new for longer.
Lipases	Capable of removing stains such as lipstick, frying fats, butter, salad oil, sauces, and the perspiration stains on collars and cuffs.

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Biotechnology adds power to cleaning and odour control technology

Environmentally friendly biological cleaning products, comprising a blend of safe chemicals and naturally occurring microorganisms, have a variety of cleaning and maintenance applications in the home as well as in large public institutions such as schools, universities, hospitals and leisure facilities. These cleaning products can be used to:

- Eliminate sources of unpleasant odour from carpets, upholstery, kitchens and bathrooms
- Deep-clean hard surfaces to remove the toughest grease and grime
- Remove grease, petrol and oil spillages from paths, garage floors and driveways
- Keep drains running freely and odour-free and eliminate stubborn drain blockages if they do occur
- Maintain clean and healthy aquaria and clarify decorative ponds
- Control odour and avoid excessive pumping in septic systems

Harnessing nature's cleaners

In nature, a multitude of bacteria and fungi secrete enzymes that break down dead organic waste matter into the essential chemical components of life. These chemical components have been slowly but continually recycled in this way since the beginning of time. Novozymes has harnessed this natural phenomenon to develop efficient cleaning technology without the need for hazardous chemicals. So wherever organic

With its exceptional technology platform of applied microbiology, Novozymes is the leading manufacturer of microbial technology for incorporation into cleaning and odour control products. The stable microbial cultures contained in biological cleaning formulations provide a safe, natural solution to dirt and odour control for institutional and household consumers alike.

waste accumulates, microorganisms and the enzymes that they produce can help to speed up its degradation and control unpleasant odours.

Microbial technology was pioneered in the treatment of industrial and public wastewater in the 1970s. Here, commercially selected bacterial strains were used to boost the activity of the native bacterial population to speed up the breakdown of organic waste contaminants. This natural approach was so effective in the treatment of wastewater that the technology was quickly extended to problems upstream such as drain lines, grease traps and septic systems. And it soon became clear that microbial technology also offered a solution to some of the dirtiest problems in the home and in public institutions.

Intelligent cleaning

Unlike standard chemical cleaning products, microbial technology offers intelligent cleaning that is tailored to the type and intensity of soiling present. In essence, each

of the billions of microbes contained in biological cleaning products is a living, self-regulating enzyme factory. The microbes detect the type and quantity of organic matter around them and secrete appropriate quantities of enzyme to degrade it.

This intelligent cleaning technology is ideal for tackling soils trapped in difficult-to-reach areas. For example, when food is spilled on a carpet, it can soak deep into the pile, penetrate the carpet backing or underlay and collect on the floor beneath the carpet. Standard chemical cleaning agents may be effective at cleaning the surface fibres of the carpet, but they cannot remove the underlying residual soils that cause stains and odours to reappear. By contrast, the microbes contained in biological cleaning products follow soils deep into the carpet, where they secrete enzymes to eliminate any organic residue, leaving the carpet thoroughly clean and odour-free.

Long-lasting effect

Biological cleaning products continue to

clean and deodorise long after they have been applied. Unlike standard chemical cleaning products, where the cleaning effect is rapid and short-lived, the microbes



contained in biological products slowly but continuously secrete enzymes to eliminate soils all the while that organic matter and moisture remain. Most biological cleaning products feature the best of both worlds, combin-

ing safe chemicals for rapid action with microbial cultures for sustained deep cleaning and freshness.

The residual action of biological cleaning products is particularly useful for eliminating the often inaccessible underlying causes of slow drain lines. Over time, domestic and institutional drains can become clogged with natural waste, grease and fat, resulting in a build-up of decaying organic material that can produce an unpleasant odour. Biological cleaning products degrade the deposits clogging the pipe, thus eliminating the problem at its source. Regular use of biological cleaners helps to prevent slow drains from becoming costly emergencies.

Safety first, naturally

Novozymes uses only the safest microorganisms for its biological technology. All of Novozymes' microbial strains are subjected to extensive safety testing.

The use of microbes circumvents the need for many of the hazardous chemicals contained in traditional cleaning products. This not only simplifies the storage and transport of cleaning products, but provides greater protection for the domestic and institutional end-user, both in general use and in the event of accidental spillages. And because the microbes contained in these cleaning products will only degrade organic waste, powerful biological cleaning products can be used without fear of damage to fixtures, fittings and fabrics. ●

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New protease beats egg

Sticky, egg-containing food residues are one of the toughest tests for automatic dishwashing detergents (ADDs). Scientists at Novozymes have developed a protease that can eliminate all trace of egg soils to deliver sparkling-clean tableware with every wash.



Egg residue presents a unique challenge to ADD manufacturers: egg contains a selection of proteins (ovoinhibitors) that inactivate traditional detergent proteases in the washing cycle, diminishing their power to remove protein-containing food soils. Novozymes has recently cracked this problem with the development of a new protease, Ovozyme® 48 T, specifically engineered to resist the ovoinhibitors contained in eggs. Ovozyme 48 T offers unique benefits, including:

- Spotless, shiny tableware every time
- Exceptional performance on egg-containing soils
- High performance, providing more space in the tablet for other ingredients

Overcoming the ovoinhibitors

In nature, the ovoinhibitors contained in egg yolk and white protect the growing chick against attack from proteases released by invading bacteria. The problem is that,

because almost all detergent proteases are derived from bacterial species, these ovoinhibitors are similarly effective in inactivating the proteases contained in dishwashing detergents. And this results in reduced cleaning performance not just on the egg residue, but on every protein-containing soil present in the same dishwasher load.

Niels Henrik Sørensen, a research scientist at Novozymes, explained to *BioTimes* that "Ovozyme 48 T is a novel engineered variant of Savinase®, one of our most successful proteases. In creating Ovozyme 48 T, we altered the protein sequence to make it resistant to inactivation by the ovoinhibitors contained in eggs. In short, we have created a very powerful protease for automatic dishwashing."

Putting it to the test

Egg soils have long been a favourite of the independent test institutes due to their stubbornness. Here, commercial ADD

soils



At independent test institutes, commercial ADD formulations are commonly put to the test on tough egg soils such as egg and milk, egg yolk and minced meat.



Samples of ADD with Ovozyme® 48 T are available from Novozymes for demonstration purposes.

formulations are commonly put to the test on tough egg soils such as egg and milk, egg yolk and minced meat. It is precisely on this soil spectrum that traditional proteases fall short of yielding the best results.

Ovozyme 48 T provides a solution. It matches the cleaning performance of conventional proteases in cycles where no egg soiling is present. But in the presence of egg residue, Ovozyme 48 T excels where traditional proteases fail - by delivering a perfectly clean and shiny result every time.

Emmanuel Petiot, Novozymes' regional European marketing manager, told *BioTimes*: "High performance results from independent test institutes are recognised as a great tool for success in the automatic dishwashing market, especially if the institutes are used by consumer associations. The key benefits of Ovozyme 48 T translate very nicely into important performance-related consumer claims, most notably the ability to deliver shiny tableware whatever the soil load."

Optimised cost performance

Until now, many ADD tablet manufacturers have been unable to take full advantage of the extraordinary cleaning power provided by enzyme ingredients. The problem is that ADD tablet formulations must fit into the small detergent dispenser to ensure that they are only released when the main washing cycle begins. Modern three-in-one ADD tablet formulations already contain pre-dosed detergent, salt and rinse aid, limiting the capacity available for the addition of enzyme ingredients. What is more, there is a growing trend for these tablets to be smaller and smaller.

Emmanuel Petiot told *BioTimes*: "Multiple traditional proteases or very high concentrations of a single traditional protease are required to overcome the ovoinhibitors present in egg-containing soil loads. It would be impossible to accommodate this quantity of enzyme in most ADD tablet formulations.

Our newest protease, Ovozyme 48 T, has an exceptionally high performance even when present in small quantities in ever smaller tablets. This not only makes it remarkably cost-effective, but will also enable our ADD tablet manufacturer customers to pack more cleaning power into their tablet formulations within the all-important size constraints." ●

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Novozymes has started up a small experimental winery in the Bordeaux district to test wine enzymes and processes under practical conditions. The focus of the latest research is on making a subtle, rounded, premium red wine.



How to make a red wine that consumers prefer

Novozymes' latest research project into wine is a pilot-scale winery designed and run by Rose-Marie Canal. It is known as the Wine Experimental Cellar (WEC) and was started up in 2002. It provides a base for testing biotechnological processing aids in winemaking - wine enzymes as well as selected yeasts and bacteria - in conjunction with Novozymes' distribution partner, Lamothe-Abiet.

Near Bordeaux

The Wine Experimental Cellar is located in the Libourne area north of Bordeaux (appellation Graves de Vayres) in France. It uses grapes from a local vineyard, and Novozymes has experimented on two varieties so far - Merlot and Cabernet Sauvignon.

All this is nothing new to Rose-Marie Canal. She grew up on a vineyard near Perpignan in the south of France, and at

working initially in Switzerland on application development and marketing for the wine industry. In 2001 she moved back to Bordeaux, where Novozymes now has its operational staff working on wine enzymes, including Rose-Marie Canal, Rémi Lévêque and Bertrand Garrigues. Rémi and Bertrand are responsible for marketing and sales worldwide in the wine industry and they communicate with distributors.

Rose-Marie and her colleagues decide exactly when to harvest the grapes, what grapes to pick and how to process them in the experimental cellar. The pilot winery's plant includes 40 tanks, each with a capacity of 2 hl and equipped with a cooling system. To ensure reliable scientific results, each experiment, including the control, is carried out in duplicate.

"Ever since the 1980s Novozymes has been extensively financing research work by sponsoring PhD students in collaboration with the Wine Faculty at the University of Bordeaux. The focus of the research has been to understand the mode of action of enzymes and their effect at molecular level," says Rose-Marie Canal. "Now we have entered a new phase in which we want to be able to demonstrate the performance of our enzymes under winery conditions. That's why we opened the Wine Experimental Cellar. It works just like a small winery and it is impossible to get results like these in a laboratory. We can integrate the use of enzymes with investigations into the winemaking process."

Redder red wines

The primary enzyme that has been tested is the extraction enzyme Vinoxym® Vintage FCE, launched in 2002. "Extraction enzymes for treating the crushed grapes represent the largest single market for our wine enzymes," comments Rémi Lévêque.

In 2002 the first trials in the WEC proved that it was possible to extract more colour and more tannins with new Vinoxym

Vintage FCE while increasing yields of free-run wine. In 2003 the effect of mechanical action during extraction and prefermentation was tested.

What consumers want

In 2004 the goal was to produce a red wine for the premium segment of the market with the help of enzymes and adaptations of the winemaking process.

"Wine consumption has always been high in traditional European markets but now wine is becoming more and more popular elsewhere in the world. Wine consumers are demanding more premium wines ranging in price from EUR 3 to EUR 6; this segment is growing," says Rémi.

To identify the best type of red wine for meeting the requirements of the premium segment, a tasting of wines produced by estates or wine merchants was organised by Novozymes and Lamothe-Abiet. The answer was a non-woody wine bottled the year after fermentation (in May/June in the Northern Hemisphere) and sold within two years at a price of around EUR 6. The desired wine should have a smooth and elegant tannin structure due to a moderate extraction. In the case of premium red wines, the consumer prefers a subtle, fruity wine that is not too astringent. The question Rose-Marie asked in 2004 as she was processing the grapes in the winery was: "How can enzymes help to make this type of wine?"

"Many of the premium red wines produced are too concentrated," Rose-Marie Canal comments. "These wines suffer from over-extraction."

The right amount of tannins

Rose-Marie also points out that there is no need to go to a high temperature at the end of maceration to extract more tannins because enzymes allow the tannins to be extracted easily at the beginning. "Consumers today don't like the taste of

The Novozymes wine team is searching for a way to make a more subtle, more colourful and fruitier red wine. From the left: Rémi Lévêque, Rose-Marie Canal and Bertrand Garrigues.



the age of six she was out in the vineyard pruning grapes. Wine and winemaking have always been a big part of her life. She studied oenology at the renowned Wine Faculty of the University of Bordeaux and completed a PhD on the release of yeast polysaccharides during ageing on lees. She has been with Novozymes since 1989,



With the enzyme Vinoxym® Vintage FCE, it is easier to release the juice and tannins from the grape and increase the colour of red wine.

a red wine made with high extraction, especially in the premium segment. Consumers want more fruity, subtle red wine, but they also want structure. They want some body in the wine, and this can be achieved with enzymes."

The concentration of tannins can vary depending on winemaking practices. The use of Vinoxym Vintage FCE - a cell wall-degrading enzyme - in a proper process allows the necessary concentration of tannins to be obtained.

When using enzymes, Rose-Marie Canal recommends avoiding an extended maceration time, reducing mechanical action (pumping over and punching down), and lowering the temperature towards the end of the extraction process.

Taste panel

March 17, 2005 was the day of the second tasting of the 2004 vintage from the Wine Experimental Cellar. Expert tasters were invited to give their verdict on the young wine. They tasted wines made in an identical way from identical grapes, with the only difference being treatment with the enzyme Vinoxym Vintage FCE. "They confirmed that the treated wines have more colour and a good structure," says Rose-Marie Canal.

The results differed according to the grape variety, but the panel generally preferred the enzyme-treated wine at this stage in its development. The Merlot enzyme-treated wine had more aroma and a more persistent flavour than the control wine. The Cabernet Sauvignon enzyme-treated wine was judged to be of a higher quality both in terms of aroma and structure. Rose-Marie Canal comments, "Our experience is that the enzyme-treated wines last longer, so we will look at these wines again in a year's time."

There has been great interest in the process to make more subtle, fruitier, smoother red wines. For those who are interested, all the research and evaluation work is carefully documented week by week during the harvest in a newsletter called *The WEC Weekly*. Winemakers and oenologists can follow step by step from when the grapes are crushed until when the wines are ready.

"The WEC is the tool we use to document product claims under winery conditions. By teaming up with Novozymes, customers will get precise information on product application according to the desired wine. This information is useful for improving production and wine quality," says Rémi Lévêque.



These tanks hold 2 hl and there are 40 at the Wine Experimental Cellar near Bordeaux.

Though the WEC is located in Bordeaux, similar results have been obtained on other grape varieties in other wine districts and countries. Based on the winery trials, Novozymes is now able to give qualified practical advice not just on the use of enzymes, but on process adaptations to make the wine that the market wants. ●

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New treatment improves 'heart oil' from



"Enzymatic degumming removes gums completely, so there is no need to add neutral bleaching earth to remove the gums," says J.S. Rao of the Novozymes South Asia office in Bangalore.

To make white rice, the brown bran on the outside of the grain has to be removed. Its oil content ranges from 12 to 25% and this oil has unique health properties. Rice bran oil is the only vegetable oil to contain oryzanol - a micronutrient that has been proven to balance levels of cholesterol in the blood. Oryzanol also reduces the deposition of fat in the arteries.

Japan began producing rice bran oil 50 years ago, where it is popularly known as 'heart oil' because of its special properties. Rice bran oil also contains a good balance of saturated (20%), monounsaturated (45%) and polyunsaturated fats (35%).

The largest producer of this type of oil is India, with an annual production of 650,000 tons.

Physical refining

The chemical refining of rice bran oil generally results in considerably higher losses than observed in the refining of other vegetable oils. This is due to the presence of larger amounts of free fatty acids and non-triacylglycerol compounds. Refining losses can be considerably reduced by using physical refining with either enzymes or acid.

In physical refining, the efficient removal of gums is very important. Acid degumming is currently the most common method in India for refining rice bran oil. However, acid degumming is known to produce inconsistent degumming results and, in general, the results are less than satisfactory. The enzymatic degumming process with the enzyme Lecitase Novo from

Rice bran oil is claimed to be the healthiest oil for the heart. As demand increases, top producers in India have adopted enzymatic degumming with Lecitase® Novo to minimise losses of oil and ensure a high-quality product.

Novozymes has been shown to be superior to acid refining. Unlike acid degumming, there is no need to use additional neutral bleaching earth in the bleaching step to remove residual gums.

Lecitase Novo converts non-hydratable phospholipids into water-soluble lyso-phospholipids, which are then removed by centrifugation. The degummed oil has a lower phosphorus content than when using the conventional acid refining process. Residual phosphorus levels of 0-5 ppm are obtained after enzymatic degumming, bleaching and dewaxing. This gives a good-quality edible rice bran oil.

The enzymatic degumming process minimises losses of oil, produces consistent degumming results, reduces water consumption, and is more environmentally sound.

Indian success

The enzymatic degumming of rice bran oil has been successfully introduced in India by J.S. Rao, a sales and technical service manager at Novozymes South Asia in Bangalore, India. "Refining companies have realised that they can earn more if they take care of the quality of the rice bran oil," he says. "Many companies wanted to make higher-quality oil but didn't know how. Our enzymes helped them to solve their quality problems."

In India, the Technology Mission on Oilseeds, Pulses and Maize (TMOP&M), a body under the auspices of the Ministry of Agriculture, has sanctioned grants of INR 7,500,000 (USD 172,000) each to 15 companies for setting up a 50-ton-a-day rice bran oil refinery employing the enzymatic degumming process developed by the Indian Institute of Chemical Technology (IICT). All the projects that have received the TMOP&M grants are monitored and commissioned by the Lipid

Science & Technology Division of the IICT in Hyderabad, India. Though the grants have now stopped, this cooperation between TMOP&M and IICT has helped to popularise enzymatic degumming in the rice bran oil refining industry in India.

Here are some comments from key companies.

A.P. Solvex

A.P. Solvex Ltd. is the largest producer of rice bran oil in India, with a refining capacity of 300 tons per day. Their brand name is Ricela. Their refinery is located in Dhuri, Punjab, and was the first refinery in India to test enzymatic degumming on a plant scale in 2002.

A.R. Sharma, the managing director of A.P. Solvex, is therefore a pioneer in the Indian rice bran oil industry. He explains: "Phosphorus is the culprit and enzymatic degumming very neatly takes away the phosphorus from the oil. Our oil quality has improved since changing over from acid degumming with phosphoric acid to enzymatic degumming. In physical refining, the phosphorus content in the oil after pre-treatment should be less than 5 ppm, otherwise there is a risk of colour reversion in the deodoriser. In the case of acid degumming, normally 10-15 ppm phosphorus is left. In the case of enzymatic degumming, the residual phosphorus is almost zero. That's why the overall oil quality is better with enzymatic degumming than with acid degumming.

"Another factor is that the refining losses with enzymatic degumming are lower than with acid degumming. In the case of enzymatic degumming, the percentage losses of oil in the gums are about 0.3-0.5% compared to 1.6% with acid degumming. That amounts to a 1% increase in oil yields for us.

India



Traditional Indian vegetarian food served on banana leaves.

"The enzyme is a biochemical, so we can claim that our oil has been refined without using any inorganic chemicals. All the methods used are physical methods and no chemicals are used anywhere."

For more information, visit the A.P. Solvex website at www.ricela.com.

Bhatinda Chemicals

Bhatinda Chemicals Ltd. is the second largest producer of rice bran oil in India, with a daily production of 100 tons at the Bhatinda unit and 50 tons at their other unit, Kissan Fats Ltd in Jalalabad, west of Bhatinda. Their oil is sold under the name Home Cook. Like A.P. Solvex, they are located in the state of Punjab, India's largest rice-growing area.

Based on the initiative of managing director Rajinder Mittal, they have been using the enzymatic process since the

beginning of 2004 at the Bhatinda unit, and since September 2004 in Jalalabad.

"I see three important benefits of the new process: lower oil losses, low phosphorus content, and reduced pollution," says Ashok Mittal, general manager for R&D. "The enzymes convert the gums to lysolecithin. The oil content of this type of gum is low, so we are getting a minimal loss of oil. We save 0.8-1% in oil losses compared to our previous process with phosphoric acid.

"If you calculate chemical costs, the savings work out at more than 150 rupees per ton of oil compared to acid degumming. So this is another major benefit.

"With enzymatic degumming, the phosphorus content is 2 ppm after dewaxing compared to 8-10 ppm with acid degumming after dewaxing. This increases the stability of the oil. The quality and colour of

the oil are better. The oil is lighter in colour.

"With acid degumming, you have to wash the oil at least once with 10% water and this generates a lot of wastewater. However, with enzymatic degumming, water treatment is not necessary. Each wash removes about 0.25% of the oil, so enzymes reduce oil losses. We estimate that total oil yields increase with enzymatic degumming by 0.8-1% compared with acid degumming."

Foods, Fats & Fertilisers

One of the most recent converts to enzymatic degumming is O.P. Goenka, head of Foods, Fats & Fertilisers Ltd. in India. His company makes a rice bran oil sold under the brand name Tandul in Southern India. After conducting plant-scale trials, he plans to introduce the enzymatic process during the second half of 2005 on a new 75-ton-a-day production line for rice bran oil at the plant in Tadepalligudem in the rice-growing area of Andhra Pradesh. "The process is able to reduce the phosphorus content to almost zero before deodorisation," he states. "So the quality of the oil becomes better and colour reversion can be avoided. Many refiners in India are switching over to enzymatic degumming for the physical refining of rice bran oil." ●



"The introduction of enzymatic degumming is new thinking. It has benefited the whole rice bran oil industry," says Dr R.B.N. Prasad (fourth from the right), head of Lipid Science & Technology at the Indian Institute of Chemical Technology in Hyderabad, seen here with researchers from his division and J.S. Rao of Novozymes (fourth from the left).

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Tackling pollution while adding unique features to textiles



Pollution is a growing problem in China. The media is increasingly focusing on this issue, and tightening of environmental standards is to be expected. Shenzhen Xinlong Linen Textile Bleaching & Dyeing Co. Ltd. is experimenting with a new enzyme to reduce pollution and develop new textiles.

As director of one of China's most advanced and respected textile factories, Zhou Lian Ya ought to be a very happy man: his printing and dyeing company in Shenzhen is supplying textiles to some of the biggest brands in the world. And with global textile quotas abandoned this year, China is set to make its mark as by far the largest textile manufacturer in the world. However, Zhou Lian Ya of Shenzhen Xinlong Linen Textile Bleaching & Dyeing Co. Ltd. is looking beyond the short-term benefits. "The textile industry will probably gain in the short run, but an increase in output will aggravate the problem of pollution," predicts Zhou Lian Ya, whose com-

pany is an industry leader in linen printing and dyeing in China. The company exports 70% of its high-quality linen to international fashion retailers such as Hennes & Mauritz (H&M), Marks & Spencer and Wal-Mart.

Pollution may dampen economic growth

Due to China's rapid economic growth, about 90% of the rivers flowing through its cities have already been heavily polluted. Scarcity of clean water has doubled the price of water in Shenzhen over the past five years, and this is a major concern for Zhou Lian Ya. He expects the price to

increase further; not only because of the scarcity of water, but also due to more stringent pollution control.

The central government is afraid that pollution will put a damper on economic growth in the future. Apart from increasingly scarce resources, funds will be diverted by the growing cost of the health sector, not to mention the human cost in terms of illness and reduced working time. "Water pollution is one of our most serious issues," says Pan Yue, deputy head of the State Environmental Protection Administration (SEPA), in an interview with *The Economist*. The textile industry is responsible for about 7% of total water pollution, with dyeing and printing responsible for half of that figure. The media is increasingly focusing on pollution, and this is putting pressure on the government to act.

Testing Scourzyme®

Shenzhen Xinlong is already more than living up to the government's current environmental standards. However, with a view to a cleaner production method as well as saving water and energy, Zhou Lian Ya has been using Novozymes' Scourzyme since 2004.

Using Scourzyme reduces the consumption of chemicals and water, and the enzyme can work at lower water temperatures than a chemical process, thus saving energy - all of which benefits the environment. "Shenzhen Xinlong is known as a pioneer in the textile industry, and it shares Novozymes' corporate philosophy when it comes to protecting the environment," says textile industry manager Nancy Zhou from



"People no longer buy clothes for simply practical reasons. They want added values like look, feel and image," says Zhou Lian Ya, director of Shenzhen Xinlong Linen Textile Bleaching & Dyeing Co. Ltd.



Novozymes in Shanghai. She is working closely with Shenzhen Xinlong to implement Scourzyme in production.

Novozymes is already selling a wide range of other enzymes to the Chinese textile industry, where the company has a high market share. "But most companies are still focusing on the productivity benefits of using our enzymes, rather than on the environment," says Nancy Zhou, adding that Scourzyme in itself is more expensive than chemicals. However, using Scourzyme is often cheaper overall than using traditional chemicals, due to shortened process times and lower energy consumption.

As well as being ahead of the anticipated tightening of Chinese pollution standards, Zhou Lian Ya of Shenzhen Xinlong is also preparing for scrutiny from abroad. The company's European and American customers have started to ask about SA 8000 certification, which includes social responsibility. "Using Scourzyme will help us to achieve this," says Zhou Lian Ya, adding that Shenzhen Xinlong is in the process of acquiring SA 8000 certification.

Novel textiles with unique fabric quality

Shenzhen Xinlong also wants to work with Novozymes to develop new kinds of textiles. Thanks to its high-quality textiles, the company has already won the China Fashion Fabric Competition every year since 1989, as well as taking first prize for its designs, and the government has designated Shenzhen Xinlong as a national linen production centre for the development and testing of new production methods. "By using enzymes we hope to develop textiles with novel properties. This way we can increase our core competitiveness," says Zhou Lian Ya. Experimenting with Scourzyme has already brought proven new and unique qualities to the linen fabric. There is less weight loss in the process, which gives the textile a thicker feeling, and the textile retains its stretching ability better. The colour yield is also higher, giving the fabric a deeper shade. "People no longer buy clothes for simply practical reasons. They want added values like look, feel and image," explains Zhou Lian Ya. ●



Zhou Lian Ya, director of Shenzhen Xinlong Linen Textile Bleaching & Dyeing Co. Ltd., and Nancy Zhou from Novozymes.

Shenzhen Xinlong Linen Textile Bleaching & Dyeing Co. Ltd. in Guangzhou province is a leader in the linen textile printing and dyeing industry. It was established in 1989 and exports 70% of its textiles to leading international fashion retailers. It was the first Chinese linen textile company to gain ISO 9000 certification in 2001.

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Amylases are an absolute must when processing pip fruit to make clear juices.



About a quarter of the normal dosage removes starch

New Amylase AG XXL is the ultimate product for achieving fast, complete starch degradation at low cost in apple and pear processing.

"Amylase AG XXL really is something new. When it was first launched in 2003, it took time for the enzyme to be accepted," says Christian Stutz of Technical Service for Fruit & Vegetables at Novozymes. "Many people simply didn't believe that you only needed a third or a quarter of the normal amylase dosage. They wanted to check it out first."

Now Amylase AG XXL is being used widely around the world. It may cost a little more per kilogram than traditional amylases, but it works out cheaper because considerably lower dosages are needed - a minimum of 50% compared to Amylase 300 L. This results in savings on amylases of 30-50%, so the cost-benefit for the user is obvious!

Laboratory trials

In early 2003, unprocessed pear juice from a juice producer in South Africa was used for laboratory trials. The pH was 3.57 and

turns blue if starch is still present in the form of amylose.)

As can be seen, only a 25-50% dosage of Amylase AG XXL was required compared to Amylase AG 300 L to achieve a negative iodine test. When a similar trial was conducted with apple juice (pH 3.25, Brix 12.1°), the conclusion was the same. These laboratory results have been confirmed many times since under industrial conditions.

The lower dosage makes new Amylase AG XXL a more cost-effective enzyme, and Novozymes believes that most customers will switch from Amylase AG 300 L if they have not already done so. Amylase AG XXL is available in a strength of 460 AGU/ml.

Greater flexibility

The new enzyme also gives flexibility because it works across a range of acidic pH values and at high temperatures.

and thermostability up to 70°C, it is a more heat-stable product than Amylase AG 300 L, the conventional amylase for the treatment of juice. It can be used in juice up to a temperature of 65°C.

It has been observed under industrial conditions that the use of Amylase AG XXL has a very positive effect on downstream processing, particularly on the performance of ultrafiltration.

Clear juice

The main component of Amylase AG XXL is an amyloglucosidase, but it also contains large quantities of fungal acid alpha-amylase.

Fresh apple and pear juices very often contain around 1.5% starch, and the proportion can be as high as 3% at the beginning of the season. This starch must be removed in order to produce clarified juices or concentrates.

Starch-splitting enzymes are usually added together with pectinases during depectinisation of the juice. The fast and complete degradation of starch avoids clarification and filtration problems in downstream processing as well as post-haze (cloudiness).

Amylases are an absolute must when processing pip fruit to make clear juices. For this application, new Amylase AG XXL is becoming the clear leader. ●

DOSAGE COMPARISON TO ACHIEVE A NEGATIVE IODINE TEST		
Temperature (°C)	Dosage of Amylase AG 300 L (g/1,000 l)	Dosage of Amylase AG XXL (g/1,000 l)
20	20	10
50	20	5
60	20	5 (slightly better than at 50°C)

With pear juice from South Africa at a temperature of 50 or 60°C, a quarter of the dosage is needed to achieve a negative iodine test when using Amylase AG XXL compared to Amylase AG 300 L.

the Brix 14.3°. The results of the trials are shown in the table. The aim was to find out how much enzyme was required to achieve a negative iodine test. (This test is used to detect traces of starch in juice. The iodine

is ideal for typical application conditions of 50-60°C and pH 3.5. Amylase AG XXL has excellent stability over a wide pH range of pH 3-6 with an optimum at pH 4. With a temperature optimum at 65°C

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