

Intelligent Drivesystems, Worldwide Services



GB

**Latest generation
bio-ethanol plant**



DRIVESYSTEMS

Innovative ecological drive technology

No-one now puts a tiger in their tank without a feeling of unease. Although *Panthera tigris* has been on the list of endangered species for many decades, there is a slight hope that it may survive. However, the era of fuels based on mineral oil is inevitably coming to an end. The future lies with non-fossil alternatives - and one of these is bio-ethanol. Up to now, this fuel has been obtained from the sugar or starch from valuable edible plants, but in Kalundborg in Denmark, it is now possible to also use straw. In the state-of-the-art demonstration plant, cellulose from straw is converted for the production of ethanol. The biomedium is churned in large drums using powerful bevel geared motors with high output torques.

Dealing with climate change is now widely considered to be the challenge of the century for the world's population. A more efficient use of resources is probably one of the most important initial measures. Therefore it is essential to reinforce the trend towards more sustainability in the production of energy:

This was a main target of the UN Climate Conference in Copenhagen in December 2009, which was to conclude a follow-up treaty to the Kyoto protocol. For the first time in years, the heads of state and government from all economically significant countries gathered to map out the way to an ecologically compatible future and a secure basis of life. Political leaders had an opportunity to get a first-hand impression of new technological approaches to solutions. The showpiece projects for the generation of alternative energy includes a demonstration plant for bio-ethanol production, which has been set up in Kalundborg by the Danish energy supplier DONG Energy. Bio-ethanol has rapidly become established alongside mineral oil products, as it is possible to mix it with the fuel for the petrol engines of most modern vehicles without conversion or other problems. There are now also several adapted internal combustion engines which can be operated entirely with ethanol, or with only a minimal addition of petrol.

Use of waste products instead of destroying harvests

Fuel produced from biomass is CO₂-neutral because during combustion it only releases the carbon dioxide which the plants used for the production of the ethanol absorbed during their growth. Up to now, from both an ecological and an economic point of view, one of the drawbacks of bio-refineries was that in addition to the significant energy consumption required for production, the use of valuable food plants as the raw material. With these plants there was a disproportion between the large areas needed for their cultivation and the small quantities of bio-fuel which were produced. The main plants to be processed were maize, wheat, sugar cane, molasses or sugar beet, due to their high starch or sugar content: these were the only substances from which ethanol could be produced. However, with new production technologies, cellulose can be used as a raw material instead of starch or sugar. For this, second generation bio-ethanol plants utilize innovative processing stages in which the cellulose molecules of the raw material are converted into sugar by means of special enzymes. This stage is then followed by the usual fermentation process. Because of this, straw can now be used instead of grain, and instead of sugar cane, its waste products can now be used. Even wood chips or compost from parks and gardens can be used as a raw material for ethanol production. DONG Energy has been carrying out research on cellulose conversion for many years. As early as 2003, a pilot plant was set up in Kalundborg. This year, the plant was extended to produce a large demonstration system.





In four 20 m long mixing drums, movement is provided by bevel geared motors mounted in pairs on the longitudinal shaft.



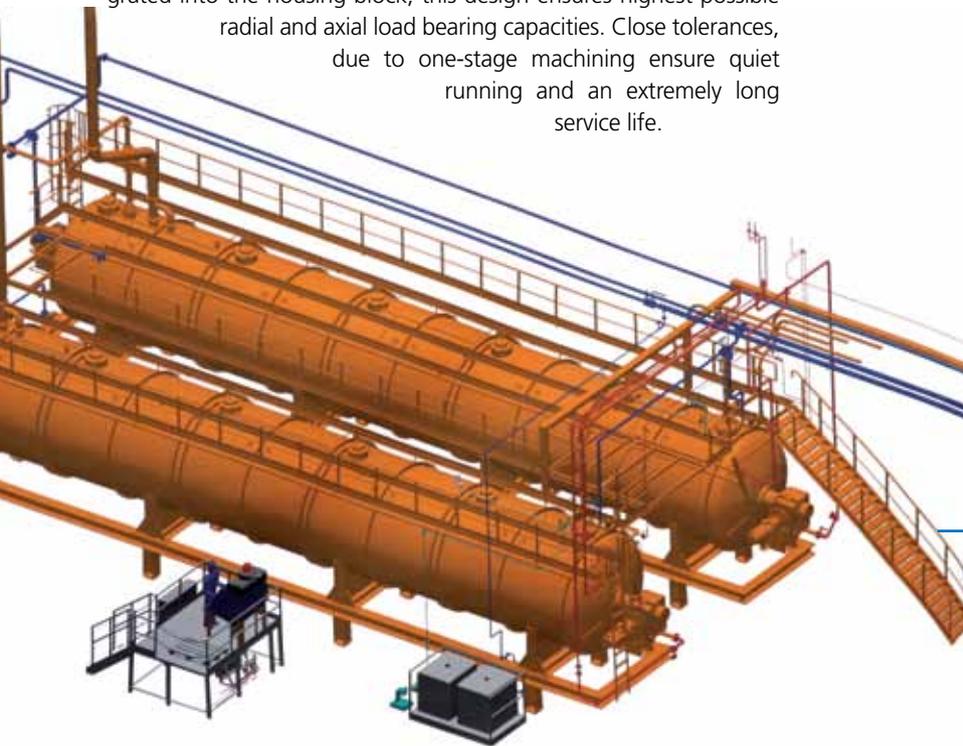
Powerful bevel geared motors mounted in pairs on the mixing drums deliver maximum output torques of over 53,000 Nm.

Powerfully rolling drums

The decisive stage of the new process is carried out in what is probably the most impressive part of the production facility, namely four 20 m long drums, each with a diameter of 3.5 m. In these, the mixture of water and finely chopped bio material is decomposed with a special enzyme, which initiates the conversion of the cellulose content into sugar. A total of 4 tons of straw are processed per hour. A shaft powered by two synchronised drive units runs through each drum. A mixing plant of this magnitude requires powerful systems with high gear ratios and large output torques. As the partner for the drive solution, NORD DRIVESYSTEMS supplied SK 9096 22 kW bevel geared motors, which are attached to the ends of the shafts by means of shrink disks. Each of these 2 ton units is also attached to a torque support which is mounted on the drum. With a gear ratio of $i = 370.95$, each drive unit supplies an output torque of over 53,000 Nm to the shaft. Bevel geared motors of this type have already proven themselves as reliable, highly robust and durable. In addition, sister models are available for the construction of even larger plants on the basis of the demonstration plant in Kalundborg. NORD supplies large-scale gear units with torques of up to 200,000 Nm, which can be combined with a wide range of braking and coupling systems as required. The fact that even gear unit types of over 90,000 Nm are constructed according to the unicast concept is unique on the market. As all the bearings are integrated into the housing block, this design ensures highest possible radial and axial load bearing capacities. Close tolerances, due to one-stage machining ensure quiet running and an extremely long service life.

Saving of resources as a guiding rule

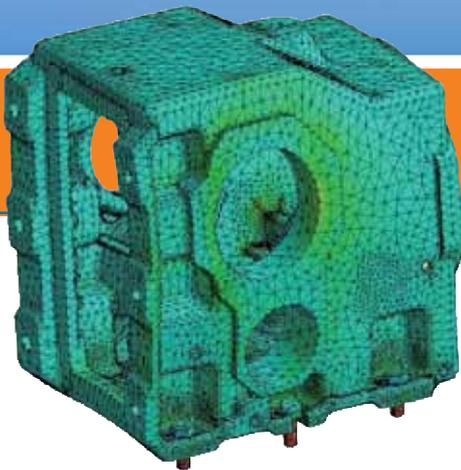
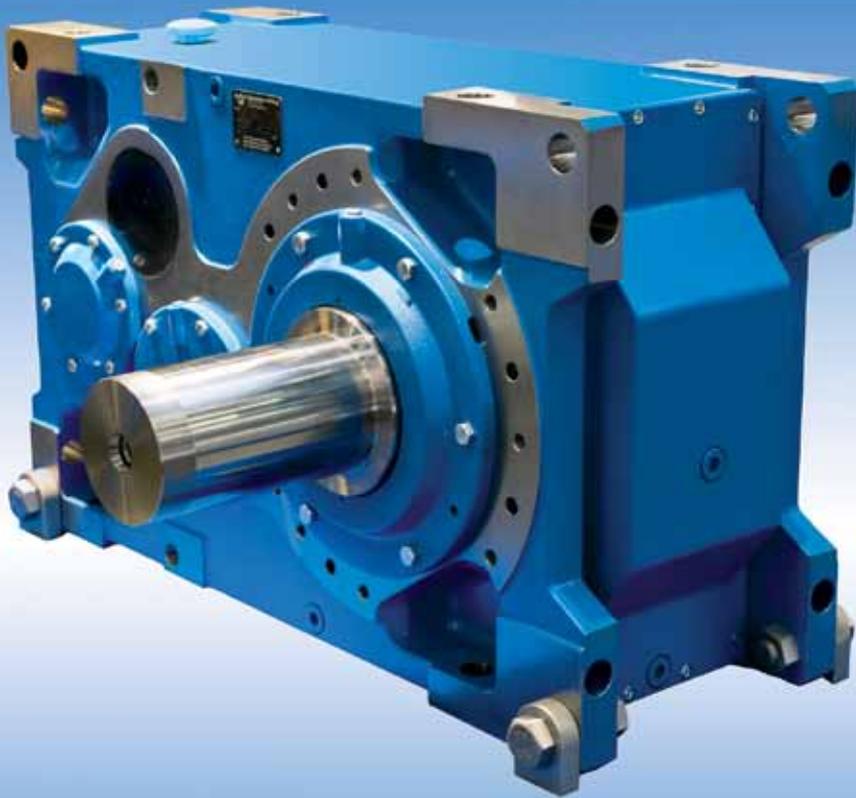
In addition to the quality of the geared motors and the breadth and depth of the range, the drive supplier was ultimately selected on the basis of the ecological profile of the manufacturer. Production plants for the generation of alternative energy are only ecologically and economically convincing if they are based on a thoroughly favourable energy balance. It is essential that the plants are equipped with machines and plant technology which are not only durable, reliable and powerful, but also fit in with the concept of sustainability. The greatest proportion of the energy consumption of any industrial plant is due to the electrical drive technology, so that the selection of energy-efficient geared motors and power electronics is especially important. For nearly one and a half decades, NORD has implemented consistent energy saving concepts for its range of products and services. These save resources and at the same time provide users with cost-saving solutions thanks to better efficiency. The optimisation of the energy, ecological and cost balance begins with small details such as our own production of gear wheels, pinions and other gear unit components in the very highest quality, and continues up to the use of copper instead of aluminium in the rotor squirrel cages of energy-saving motors.



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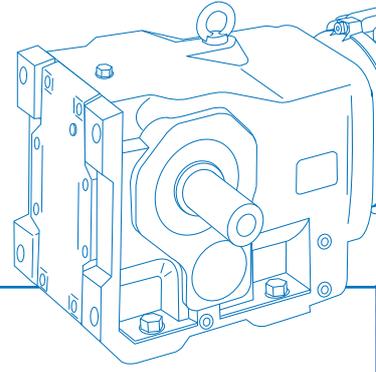
For larger plants on the basis of the technological demonstration in Kalundborg, the NORD range includes industrial gear units with torques of up to 229,000 Nm.

Even large drive solutions from NORD DRIVESYSTEMS can be very flexibly configured with the modular system - in this case a 3-stage SK 9096.1 with motor and clutch.



FEM-based calculations ensure highest levels of strength and load bearing capacity in the design of large gear units

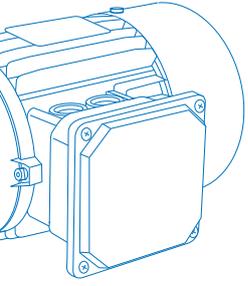
Efficient use of renewable resources



Summary:

The latest generation of bio-ethanol production plants take a great step towards more efficient utilisation of sustainable resources: In future, previously unused waste products from plants can be used as the raw material for bio-fuels. With this, "bio-fuel" can become an even more important component in the mixture of future energy sources, which urgently needs to be found for the existing and growing number of vehicles in the world as easily accessible mineral oil reserves become exhausted. The DONG Energy demonstration plant in Kalundborg in Denmark is a model for sustainable energy production in every respect. It presents a new approach at a site which implements consistent recycling and synergy concepts and combines these with appropriate plant technology. Technologically and ecologically convincing drive solutions perform reliably here and make a significant contribution to the favourable overall energy balance.





Sustainability through integration on site

Even second generation bio-ethanol plants still need a great deal of energy for the necessary stages of the process. In order to optimise the energy balance of the production process, sustainable solutions of a practical model nature were required for the demonstration plant. Therefore, not only was energy consumption to be kept as low as possible but, as far as possible, waste products were to be able to be processed. The Kalundborg plant achieves this by comprehensive integration of the system in the recycling cycles of the site: The bio-ethanol production was set up in the immediate vicinity of a combined heat and power plant, whose waste heat is used directly for processing the straw. In turn, the waste products from the production plant, in which for each ton of straw more than a quarter of a ton of solid bio-fuel are produced, are fed to the power plant. Thanks to its high heating value, when this fuel is burned it produces more energy than is consumed by the production processes in the ethanol plant. The small quantities of waste water which the production plant produces are also recycled in the power station for washing the flue gases. Even the so-called C5 molasses, which is produced in considerable quantities as a waste product in addition to the solid bio-fuel, is sold as cattle food by a nearby agricultural cooperative. In return the cooperative supplies the production plant with straw. Further technological advances in the future will probably enable the fermentation of the sugars in the molasses into alcohol in order to improve the ethanol yield even further. Even the actual product, bio-ethanol, is used locally. A Statoil refinery mixes it directly with the petrol which it produces.

In Kalundborg in Denmark, the new DONG Energy bio-ethanol plant is integrated into the sustainable cycles of the site, which include an electric power station.

Getriebebau NORD - Company background

With about 2,300 employees, NORD develops, produces and sells drive technologies, and is one of the international leaders in the industry. In addition to standard drives, NORD supplies application-specific concepts and solutions, even for special applications, for example with energy-saving drives or explosion-protected systems. The company, which was founded in 1965, recently achieved a turnover of around 264 million Euro. At present it has over 35 subsidiaries around the world. The closely meshed sales and service network ensures optimum availability for short delivery times and customer-oriented services. NORD produces a wide variety of drive units for torques from 10 Nm to 229,000 Nm, electric motors with powers from 0.12 kW to 200 kW as well as the necessary power electronics in the form of frequency inverters and servo controllers. Inverter solutions are available both for conventional installation in switching cabinets as well as for decentralised and fully integrated drive units.





www.nord.com/locator



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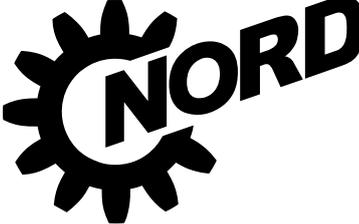
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