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# NORNER NEWS

# 09

**Improvements in Oil production**

**Packaging performance and control**

**New monomers and polymer analysis**

**Data storage for next generations**



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## 3@Norner



**Katrin Nord Varhaug**

*Hello, I am working with composites and project manager at Norner for the C6 technology projects. I like new challenges like this and the success.*



**Liv Thobru**

*Hi, as polymer analyst I am very excited about the new investment in GPC-IR. With this we can achieve more for our clients. That is very inspiring.*



**Svein Jamtvedt**

*Hi, I deal with additives and suppliers and was responsible for the testing of new antioxidants from Sumitomo. Chemistry is Cool!*



*As an innovation company we shall chase new ideas and strive to be ahead of the industry predicting where we can be of help to create value for them in the future. To further strengthen our journey, we have sharpened our focus and company business vision.*

## Dear reader

### The Polymer Explores - Bring the material solutions to the next level

So far 2016 has been a year of global changes and challenges. Within this picture, we see a society developing in full speed forward striving for a more sustainable utilisation of our global resources.

At Norner, we also have to take our share of responsibility - in areas where we actually can influence. We are developing lightweight material solutions, biobased raw materials and build up new knowledge in Marine littering. We will just start up a Norwegian pilot study sponsored by Norwegian Industry to investigate the origin of the plastics polluting our sea. And - we do utilize one of our company values = Passion! This spring, most of our employees gathered one evening to clean and sort the garbage on a local beach to make our small contribution as you can read about in this magazine.

As an innovation company we have to hunt for new ideas and we have to be ahead of the industry predicting where we can be of help to create value for them in the future. Thus, we have during the last year further developed our technology strategy, covering technology areas where we strongly believe we can contribute as problem solvers.

The Technology forefront areas are:

1) Advanced Polymer Composites covering thermoplastic polymer in multiple applications and polymer

Nano composed to radically plastics performance.

2) Development of Green and sustainable rawmaterials and utilization of them

3) Polyolefin process technology and the products- an area where we develop own technologies and also in the future will bring added value know-how to our clients globally.

Through this strategy we do envision that we have the right tool books to solve the challenges from the market coming also 5-10 years from Now.

To further strengthen our journey, we have sharpened our focus and company business vision. Our new leading star is to be;

The Polymer Explorers, - being forward leaning and have a leading polymers expertise globally.



In this magazine you will read about – many interesting areas already ongoing that do envision our message and pointing out our visionary direction.

Visionary regards & Happy Reading!  
-Tine



# Highlights

## Packaging Prize for Ole Jan Myhre



Ole Jan Myhre, Market Manager at Norner has been awarded as "Packaging Professional 2015" by the Norwegian Packaging Association. He was recognized for his outstanding work and knowledge sharing in Plastic Packaging.

## New employees

We are happy to welcome two new employees in our technology centre.

Kjetil Helgesen, M.Sc. in Physical chemistry from University of Oslo, and background from pharma and oil&gas will join the analytical team of our scientific laboratories.



Kai Arne Sætre, M.Sc. in process technology will start in Norner R&D as a senior process engineer. He will bring valuable experience in process simulations.

## Dr. Fredriksen enter research board



Dr. Siw Fredriksen enters the board of Norwegian Oslofjord research fund which provides grants for research projects in the counties of Buskerud, Telemark, Vestfold and Østfold with the aim to create regional growth.

We are proud of the appointment that shows that our researchers have high recognition and Norner is a significant technological R & D centre in the region.



## New exposure testing house

Due to a high increase in testing assignments in plastic parts, gaskets and marine coatings we are expanding our test facilities and installing all our autoclaves in a new facility.

The new testing house makes the autoclave testing, sample preparation as well as monitoring and accuracy even more efficient and reliable. Read more on pg. 7,



## New Vision

This spring we gathered the whole company for a workshop and team building at the beautiful golf resort in Kragerø. The main aim of the workshop was to develop our new vision together.

As with our values we believe the best way to set common targets is by doing it together - The Norner Way.

Based on all the input it became clear that our new leading star is to be:

**The Polymer Explorers**

This set our ambitions and the expectations of our customers.

# Our location - Norway



Ole Jan Myhre  
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Our location in Norway is in the county of Telemark, said to be a Norway in miniature. The county is green and clean with large forrests, wide mountains as well as blue ocean and archipelago.

We have a proud industrial heritage in Telemark too. The region has been export focused for more than 1000 years - back into the age of vikings. The first industries included timber, honestone, iron and ice. Based on the development of hydropower this extended into fertilizers, metal alloys, porcelain and cement before petrochemical industry was built in the 1970ies.

Several hundred years of export also lead to a strong shipping tradition and ship building industry. This required high quality and presicion. Therefore, the certification and insurance of ships, was also born here.

Norner provides industrial polymer services from our technology centre to >600 customers in 60 countries

Norner was founded in 2007 as a full transformation of the international innovation centre located at the Borealis petrochemical site including employees, competence and laboratory assets. Through a major re-structuring,

our employees with over 30 years of experience (then) established a fully independent technology partner in the fields of petrochemicals, material technology, plastic applications, plastic additives and scientific lab services.

Our target was to utilize our competence to create better value for our customers. Norner has now more than 600 clients in 60 countries and is recognised in the market as a polymer and plastics solution provider with industrial know-how. We live our values; Confidence – Impact – Imagine – Passion.

## The Polymer Explorers



We look forward to continuing the journey, deliver sustainable solutions making a difference, and bring ideas for the future from our Norwegian technology centre!



TELEMARK

# Telemark - our heritage







# Meet us at - leading international events

## ONS 2016

Aug. 29 - Sep. 1, Stavanger, Norway  
Visit us at Hall 4 Stand 439



## Kjemikaliedagene 2016

October 19-20, Oslo, Norway  
Presentation of paper by Thor Kamfjord



## Polyolefin Additives 2016

September 13-15, Cologne, Germany  
Presentation of paper by Svein Jamtvedt

PolyolefinAdditives2016

## Agricultural Films 2016

September 20-22, Barcelona, Spain

AGRICULTURAL  
FILM 2016

## K'2016

October 19-26, 2016, Düsseldorf, Germany  
Visit us at Hall 7.1 stand C25



## Multilayer Packaging Films 2016

November 15-17, Vienna, Germany

Multilayer Packaging  
Films 2016

## Thin Wall Packaging 2016

Nov. 29 - Dec. 1, Cologne, Germany

THIN WALL  
PACKAGING 2016

## Petrotech 2016

December 5-7, New Dehli, India  
Presentations by CEO Tine Rørvik and Lars Evensen



## Oil & Gas Non-Metallics 2016

December 12-14, London, UK  
Presentation by Jørgen Nyhus

Oil & Gas  
Non-Metallics 2016

# Breakthrough in oil production



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InflowControl enable a substantial increase in oil recovery with their next generation inflow control valves, which is completely shutting off both water and gas.

Globally, only some 32% of available oil reserves are extracted from oil fields mainly due to loss of pressure to drive out the crude. Several Inflow control devices have been developed in the past, to balance the pressure in the wells or to reduce the impact of water or gas breakthrough.

Now, a new generation so-called autonomous inflow control valves (AICV) has been developed with the ability to completely shutting off both water and gas. The AICV® is completely self-regulating, and does not require any form of control, electronics or connection to the surface.

This provides the operator with a significantly more efficient production and increased recovery.

The AICV® technology enables opportunities to drill longer wells and achieve maximum reservoir contact of each well. In addition, the AICV®

removes the risk, cost and requirements for separation, transportation and handling of unwanted fluid.

Norner has helped InflowControl through two major research and development projects, one funded by EU (see Norner News 04). Our work has been as polymer material experts and as testing partner.

Norner evaluated elastomeric materials and components made of these elastomers. We developed new test protocols and equipment for testing under realistic physical and chemical conditions, in order to document long-time use (> 25 years) under dynamic loads (full functionality).

The new application tests were combined with standard testing such as ISO 23936-2 and NORSOK M-710, and materials were evaluated under several chemical and physical conditions. Polymer testing was performed in both crude blends as well as synthetic oil mixes, using both sweet and sour (H<sub>2</sub>S, CO<sub>2</sub>) gas.

**Norner has a range of test autoclaves and is expanding the services and capabilities**

See next page for an update on our autoclave test capabilities.

We are very happy for InflowControl's success and for taking part in their development of a breakthrough technology for a more environmentally friendly, safer and more profitable oil production.

Our work will be presented at OIL & GAS NON-METALLICS 2016, in London 12-14th December this year.

## ONS Innovation Award

InflowControl is one of the finalists for The ONS Innovation Awards. Ten finalists were chosen by the jury to compete for the recognition as the most innovative companies of the energy sector.

InflowControl is nominated for their technology Autonomous Inflow Control Valve. This is a successful innovation and we are proud that the work carried out by Norner contribute to their success.

Their AICV® has the last year been qualified and successfully installed in both offshore and onshore wells all around the world. AICV® wells have been sold to oil companies in Saudi Arabia, Canada, Norway and China.

Read more about InflowControl on their homepage [www.inflowcontrol.no](http://www.inflowcontrol.no)



# We strengthen our footprint of services for oil & gas

We have increased our capacity in autoclave testing and strengthened our service level for our customers.

Norner has very long experience in handling high pressure and high temperature together with aggressive fluids and gases. Over time, we have built up a good capacity in autoclaves suitable for handling and expose samples under such conditions.

The Oil&Gas industry grow their use and development in lightweight and durable polymer solutions, which shows that plastics are important and a growing material family. Plastics provide also a number of other material advantages like cost efficiency, no corrosion, corrosion protection, insulation and buoyancy.

Material selection, development, specification, testing and verification is a key service area for Norner and we will make sure we have capacity

and capability to meet our customer needs.

Norner is now proudly offering a range of autoclaves, from small 400 ml up to 5 litre size. The alloy selected is suitable for all gases and media including H<sub>2</sub>S, CH<sub>4</sub> and CO<sub>2</sub>. Most of the autoclaves are certified to be used at 325°C and 300 bar. We also have the possibility to test at up to 700 bar if needed. Rapid Gas Decompression (RGD) testing is naturally a part of our offering.

Our new test house is state of the art in safety and will secure an efficient handling of assignments from our clients. The facility is built from scratch with only one purpose; Ageing materials in extreme conditions.

The ageing is typically followed by mechanical testing, hardness, swelling, additive mapping and microscopy evaluations.

In addition to standard testing, we offer functional testing and specially designed test programs. We make sure that the samples are tested in such a way that it resembles the specified environment the polymer shall be exposed to.

**We look forward to show you all our opportunities!**

Norner has besides advanced testing, many polymer scientists that assist in selecting the optimal material for your need. This can be linked to improved cost and performance for existing solution or finding new replacement material that meet the requirements set by our customers.



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The most relevant test standards for oil&gas at Norner are;

- Norsok M-710 incl. RGD
- ISO 23936 part 1 (Thermoplastic) & 2 (Elastomer)
- ISO 12736, Wet thermal insulation coatings for pipelines, flow lines, equipment and subsea structures
- ISO 10423, Annex F, Drilling and production equipment -- Wellhead and Christmas tree equipment
- API, CSA and NACE standards



C6 Technologies is an oilfield technology company offering new solutions for well intervention and conveyance, utilizing composite materials.

Well intervention, or well work, is any operation carried out on an oil or gas well during or at the end of its productive life. Such work is carried out in order to modify the well, provide well diagnostics or manages the production of the well. C6 introduce innovative concepts with performance beyond what established technology in the oilfield can provide today. As a result, this will be extending the life of the well, reducing drilling costs and maximise the yield of the well.

Novel, efficient well intervention methods have increasingly been requested by operators as more and more mature fields have complex well-designs, and in addition ultra-deep and extended reach wells become common place for new field developments.

C6 Technologies have developed the ComTrac® system that utilize a light-weight, semi-stiff composite rod with

embedded conductors and fully exploits the many benefits of composites.

The current state-of-the-art composite rods have material limitations that prevent their use for service in down hole conditions at temperatures above 150°C.

There is a need for material solutions that will allow well interventions in the most

funding from the Norwegian Research Council "Petromax" research grant. The CompEx project for developing cost efficient and environmentally friendly well intervention technology for extended operating was started in 2014 and has achieved several of the key milestones. The project work include material and fibre selection, composite development and verification testing at high pressure and temperature.

## Well innovations by C6 Technologies..

challenging and extended operating environments, for temperatures of at least 177°C, pressures up to 1 000 bar and depths up to 10 000 m.

This will be solved by developing novel composites that will constitute the next generation of composite rods and enable using the ComTrac® system in such extended operating environments.

C6 Technology's ComTrac® System reaches further in highly deviated, deep and extended wells.

For this development work, C6 Technologies have been rewarded with



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Norner have used several test procedures in the project. Some of these are;

- Exposure testing under severe conditions in autoclaves.
- Thermal properties of the polymers and composites
- Tensile strength flex modulus and Impact resistance
- Inter laminar shear strength
- Microscopy investigations





The high ambitions and advanced material solutions required in the Compex project called for a highly competent research partner.

C6 technologies chose Norner as a strategic partner for their R&D program in well intervention rod technology. We had the right expertise within polymer materials and test facilities for high pressure and high temperature testing under critical environmental conditions.

We have been responsible for selecting

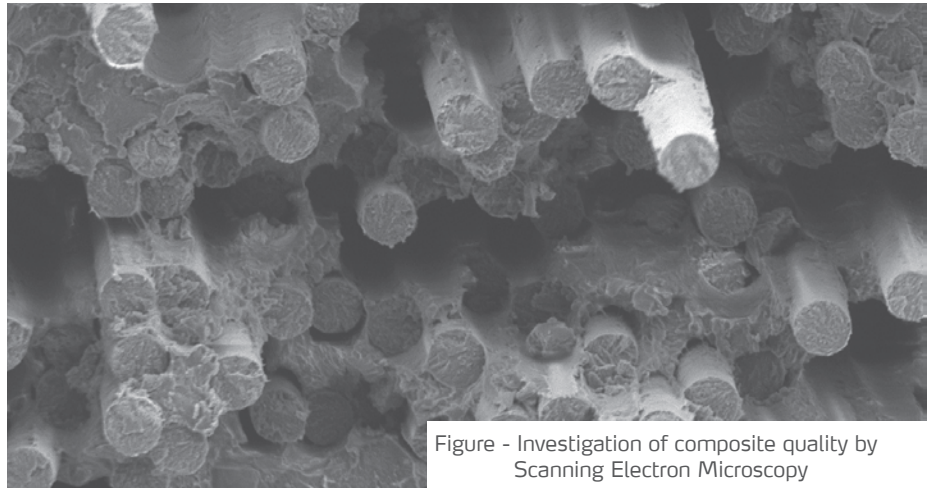


Figure - Investigation of composite quality by Scanning Electron Microscopy

microscopy and physical properties are measured to compare the exposed and non-exposed samples.

Test equipment was built up to suit the individual needs in this project and test parameters has been agreed in order to secure closest resemblance with the specified environment the polymer shall be exposed to.

The project has allowed Norner to extend the competence in the field of composites, making us the selected partner for C6 Technology on a long term basis.

C6 Technologies has been selected to take part in the prestigious Innovation Park pavilion during the upcoming ONS exhibition in Stavanger.

You can read more about them at their home page [www.c6technologies.com](http://www.c6technologies.com)

# ..with some help from Norner

the materials being used in the rod development, both the polymer and the fibres. This was done in close contact with material suppliers. The development work has been carried out both in lab and pilot scale. An important tool in this development work has been to use experimental design to find the optimum process settings for the long fibre reinforced composite materials.

Testing of the selected materials and

the composite products being made in lab scale or pilot scale has been very important in order to verify the performance. The new materials must withstand very high target service temperatures and conditions specified by C6 Technologies has selected.

Exposure and compatibility testing has been a key test area where Norner has valuable expertise. After exposure, the samples may be evaluated by



# 3-Methyl-1-butene

## A new monomer opportunity

Polyolefins continue to bring new technology developments to the business. Evonik have, together with Norner, recently demonstrated the benefits of a novel patented monomer.

The business of polyolefins is based on polymerisation of linear alpha olefins like ethylene, propylene and butene. PE and PP materials have conquered the plastics market and represents close to 50% of the total consumption.

When Evonik wanted to explore their 3-Methyl-1-butene as a co-monomer alternative for low pressure PE, they initiated a cooperation with Norner. This C5 monomer would be beneficial for Evonik if the advantages could be proven.



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At Norner lab pilot centre, polymerisations can be carried out and simulated for:

- Gas, slurry and solution phase
- Ethylene and propylene with various co-monomers
- Single and multi reactor set-ups
- Reactor size from 0,5-17 litre

The produced materials can be

- compounded, analysed, processed to prototypes and widely tested in our scientific laboratory

Our polymerisation trials actually demonstrated substantial saving potentials.

3-Methyl-1-butene was tested in the two most common processes for LPPE; Gas Phase and Slurry reactors. (GPR) technology is the most common in polyethylene.

For the Gas Phase and Slurry we achieved:

- 2 times higher polymerisation activities with 3M1B compared to 1-hexene or 1-butene
- This was observed for both ZN and metallocene catalysts.

In practise, this activity increase means significant savings in the polymerisation process economy. Furthermore almost 2 times more wt% hexene-1 must be incorporated in PE compared to MIB to obtain the same polymer density which

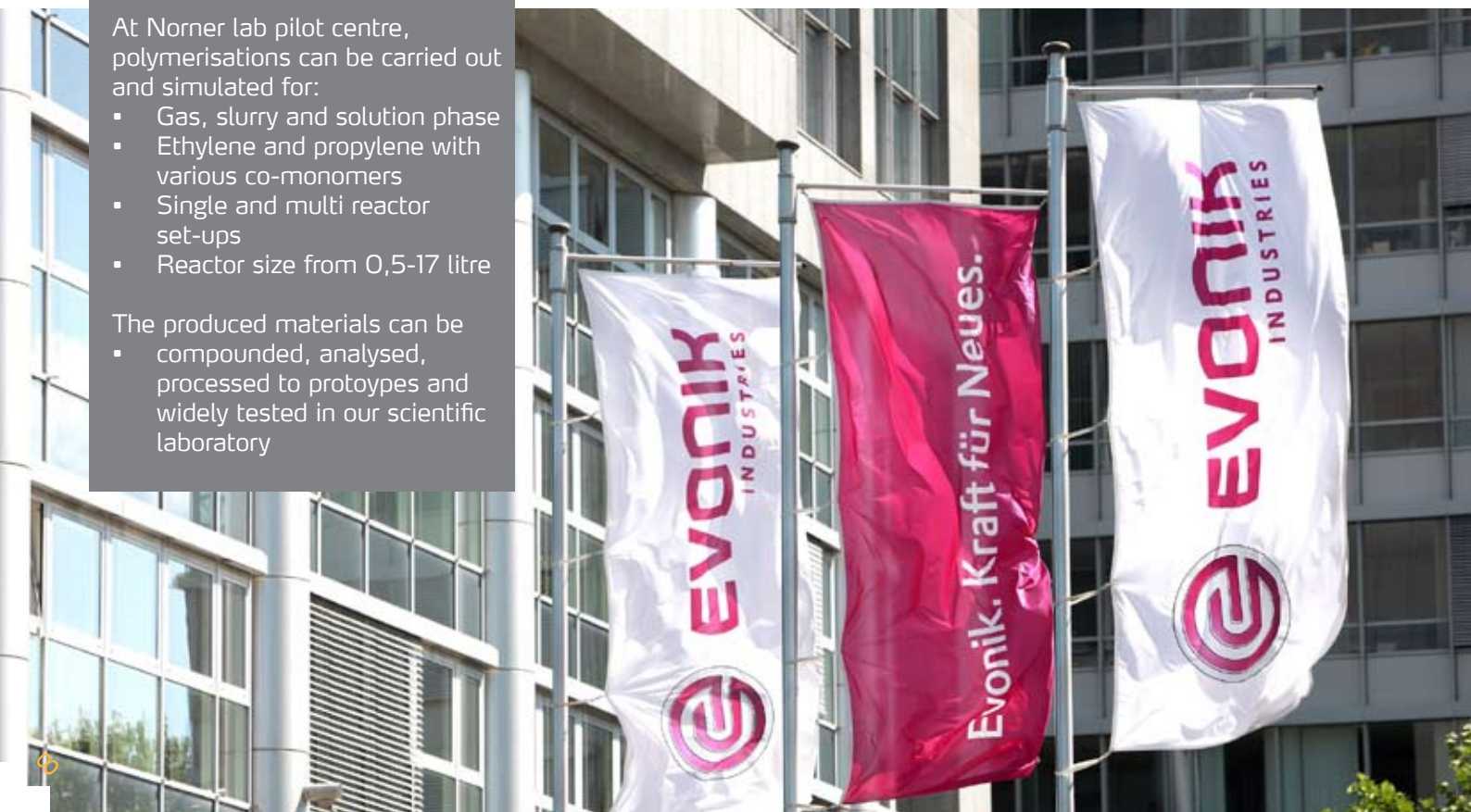
gives savings in co-monomer costs.

Higher catalyst activity and reduced comonomer usage give lower costs

Another advantage is the low boiling point of the monomer compared to hexene. This is an important subject in the hydrocarbon recovery processes in the polymer plants. It also means that 3-Methyl-1-butene can be used as a cooling agent and comonomer simultaneously in Gas Phase process.

The mechanical properties of the PE model grades with 3-Methyl-1-butene was typically very similar as for 1-hexene based PE copolymers.

We have discovered new opportunities together and created a fundament for a new business.





# Investments in new polymer analysis

We have expanded our polymer testing capability with a new high temperature GPC/SEC-IR, which add on to a wide range of analytical options.

Gel permeation chromatography (GPC) is a type of size exclusion chromatography (SEC) used to analyse molar mass composition of polymers. The new instrument is a state of the art GPC-IR from Polymer Char.

GPC-IR gives the opportunity to analyse both the Molar Mass composition and concentration.

Short Chain Branching (SCB) can be analysed over the molar mass

distribution. With the highly sensitive IR-5, detector this is also possible at low concentrations. The IR-5 detector have absorbance channel for CH<sub>2</sub> and CH<sub>3</sub>.

Viscometer gives information about polymer intrinsic viscosity (IV) and Long Chain Branching factor.

Within all our polymer analysis disciplines, we carry out a broad spectrum of specific tests. These methods have been developed and implemented to fulfil the needs from different parts of our polymer value chain. For this reason, we can pull complex conclusions based on our analytical results and tools.

Contact us today for advanced GPC analysis, measurement support

We also perform a wide range of other polymeric analyses. See the below list or visit [www.norner.no/laboratory-testing-services](http://www.norner.no/laboratory-testing-services)



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Our polymer analyses:

- High temperature GPC / IR
- High temperature GPC / Visc
- Room temperature GPC
- Infra red spectroscopy (FTIR)
- UV-VIS spectroscopy
- Differential Scanning Calorimetry
- Dynamic Thermo Mechanical Analysis
- Termo Gravimetric Analysis
- Thermal conductivity K-value
- Capillary Rheometer
- Dynamic Rheometer
- Melt Flow Rate and volume index
- Intrinsic Viscosity
- Water content
- Liquid Chromatography
- GC-MS Gas Chromatography





## Focus on marine litter Norner Beach Cleaning Day



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Marine litter is a growing environmental challenge we face today. A high degree of this litter is plastics and because it floats, it moves across large distances.

It is a complex issue, which has a negative impact on our world's oceans, seas and rivers, harming wildlife and fisheries in Norway and around the world.

The plastics experts in Norner took part in the national "clean a beach" initiative in Norway this spring.

Even if plastics is a material with superior performance at unbeaten light weight well suited for material recycling it is a serious problem if it comes into the oceans.

We wanted to address this global challenge by acting local and chose the beautiful Rakkestad beach in our home municipality Bamble. 27 enthusiastic Norner experts, lead by our CEO Tine Rørvik took part in this action.

"It is great to combine something so useful and environmental friendly with some social get-together with nice colleagues. We challenge other plastics companies to also act local for the global littering problem." Says Tine Rørvik, CEO of Norner AS

What we in practice did was to:

- Clean all litter on the 200m long Rakkestad beach
- Sort the litter in relevant fractions, weigh and document
- Report the findings to the Norwegian "clean a beach" initiative

We picked up all we could find and we really found much interesting stuff. We picked all together 45kg of litter, which included metal boxes and -scrap, glass bottles, rope and twines, moorings, various hard plastics (boxes, pipes, utensils and fragments), plastic bottles, plastic film, toys and clothes.

According to World Wildlife Found (WWF) and OSPAR 2009 about 6,4 million ton of litter ends up in the ocean

each year globally of which 15% ends up on beaches, 15% floats into the ocean and 70% sink. This must be dealt with through litter collection and with initiatives by industry, NGO's and citizens like "Zero landfill", "Clean a beach" and various research to understand the problem.

Our shared concern for marine littering has resulted in a Norwegian pilot project sponsored by the industry to explore and analyse samples. This will include plastic type and origin, content of chemicals as well as wittering behaviour and fragmentation into microplastics.







# Innovation in polyolefin stabilisation



In response to market need for novel and efficient solutions Sumitomo Chemicals have developed a unique range of plastics stabilisers.

Plastics need some help of stabilisers, i.e. antioxidants, to retain their high performance after extrusion at elevated temperatures and during their use.

In order to test and verify the efficiency of Sumitomo's newly developed antioxidants, they turned to us in Norner for assistance. Our long term experience with additives testing and analysis was the decisive factor.

Sometimes more advanced polymer polymerization technology is required for a proper response to market needs. For example, higher processing temperature is required for thinner film extrusion, and therefore higher stabilisation will be required. An increased amount of processing stabiliser might work, if the processing temperature isn't too high and the film isn't too thin.

For use in food wrappings or electronic components, it is more necessary than ever that the additives, their decomposition products or polymers that have low molecular weight are not transferred to the food or the surface

of the product, so that contamination of the product and/or the mold due to bleed-out will not occur.

It is common to use a combination of phenolic antioxidant and a phosphoric antioxidant as processing stabilizers.

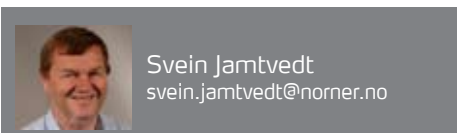
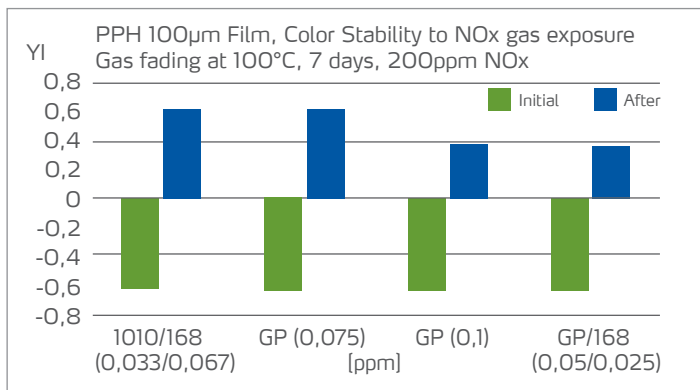
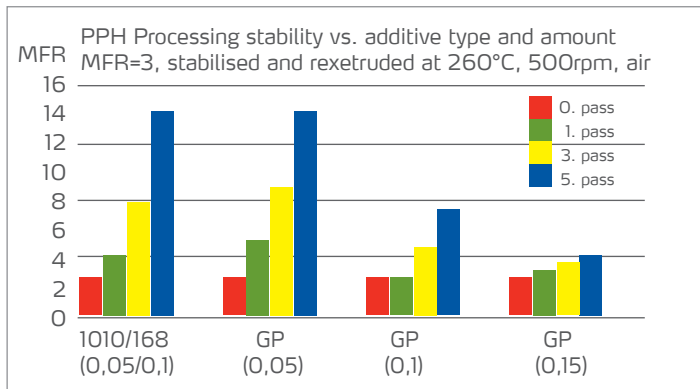
The focus of Sumitomo's development was to develop a more modern and efficient system which also could reduce the total amount used with better purity for the given application. The result was their G-series of SUMILIZER® additives and all was tested by Norner.

Norner have made a thorough work on assessing the efficiency and performance of the SUMILIZER® GP in both LLDPE and PP materials. A unique feature is that it contains both a phenolic and a phosphoric antioxidant in one chemical molecule.

Because of this dual functionality the SUMILIZER® GP is capable of neutralising all different radical reactions in the polymer matrix.

Our experiments was carried out with virgin polymer powders and we compounded selected additive recipes of SUMILIZER® GP and the standard reference package on a twin screw extruder under N2 blanket.

The compounds was investigated and analysed. The figures below shows the influence of multiple extrusion on the polymer colour and MFR. We also tested the stability against gas fading which was excellent.



- Our additive services cover:
- Quantitative analysis of organic additives by GC or LC
  - Quantitative analysis of in-organic additives by SEM/EDS
  - Analysis of NIAS in polymers
  - Additive identification with FTIR
  - MIgration analysis
  - Food (EU/FDA), Reach and Pharma advisory
  - Physical testing of the effect of additives
  - UV, WOM and wide range of other ageing testing
  - Compounding and extrusion



## Take control of your packaging material performance



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Plastic material type, grade or recipe actually determines 80% of the packaging performance

Packaging shall fulfil several functions. First, it must protect and contain the product and function well in a packaging machinery. Secondly, it needs to withstand the conditions of logistics. Then it also must give a nice presentation of a consumer product.

We experience all too often that companies are more concerned with creating a design-oriented specification. I.e. how should the package look like in dimensions, geometry, thickness, appearance including print designs and colours? However, a packaging may fail in many ways if these are the only criteria. It is vitally important that also relevant material and physical performance are included in a specification.

If the package works well everybody are happy but - be sure that problems may occur if and when something changes like new supplier, colour or when supplier change resin! Therefore, it is important for packers and brand owners to:

- Define, test and control critical properties
- Limit and approve the allowed polymer resins
- Develop procedures for approval of new resins
- Check compatibility with content and functionality
- Carefully test any mould changes and new designs
- Observe if cost reduction activities may reduce performance

For food packaging we also need to include content of chemicals vs. EU 10/2011 since authorities demand testing and documentation for food contact. This is also relevant regarding UN testing of packaging for dangerous goods.

Let's have a closer look on Polypropylene!

PP may be defined by many parameters, which all will influence the package performance:

Molecular Weight (Mw) which again determines the Melt Viscosity (MFR) and have major influence on processability, mouldability and strength.

Melting temperature (Tm) which determines critical temperature for use.

Further important is the comonomer and its incorporation and content. This have major impact on impact resistance stiffness/softness, optics and sealability.

The main classes of PP are:

- Homopolymer = stiffness
- Random copolymer = optics
- Heterophasic copo. = impact
- Soft PP = soft

In addition a variety of nucleation agents, functional additives and stabilisers are used which impact both on performance and food contact regulation.

This ends up with a very high number of grades/resins with a wide range of performances. Even very similar materials may give very different performances as the figure below shows. The four selected grades in the comparison are very similar PP heterophasic copolymers, which all have same viscosity. These differences are a result of the design and production of the rubber phase of the copolymer.

Specific impact tests shows >3 times difference in impact resistance!

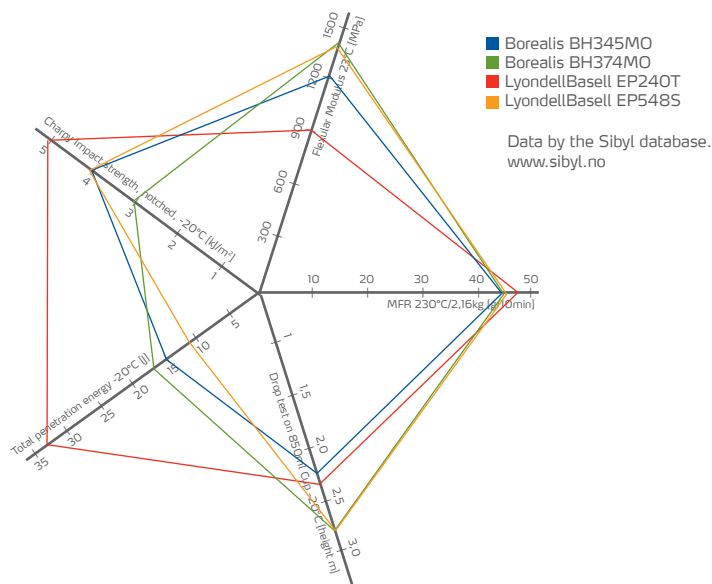


Figure: Properties of MFR45 PP heterophasic copolymers.



## Purity is critical for food and pharma - how do we manage?

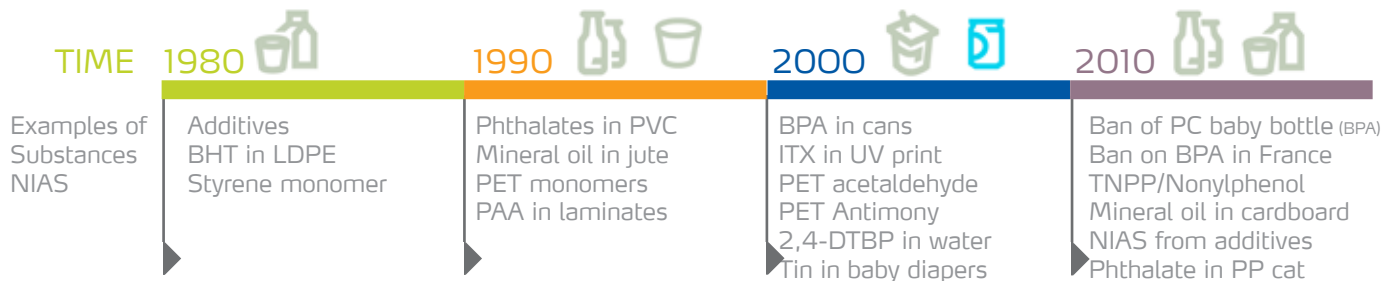


Figure: Examples of incidents and cases of chemicals in plastics and packaging

Continuous research about purity and migration reveal doubts about chemicals in plastics for packaging and pharma.

Human health and safety is a high focus area for global food producers and medical companies. Even the smallest concentrations of doubtful substances may be critical. More knowledge about health impact of chemicals are developed which may lead to new restrictions.

Food contact materials are regulated in EU No. 10/2011. This gives instructions to allowed monomers and additives. It also deals with the topic of Non Intentionally Added Substances

(NIAS) in plastics and states that all substances >10ppb shall be identified and accounted for.

During the last 25 years, several cases of questionable chemicals and NIAS have been published as illustrated in the above figure.

Regulation (EU) No. 10/2011 gives a clear definition for NIAS as any impurity in approved substances:

- Reaction intermediates formed during the production process
- Decomposition products
- Reaction products

The production of food contact materials (FCM) can never be free of NIAS. FCM are also often complex, e.g. multilayer, combinations of different materials with the use of adhesives and inks.

During our research project, "Chemicals in Packaging", we have analysed NIAS in a wide range of plastics packaging. In most cases the results are very positive but some need deeper investigations.

Norner have a high focus on these matters and provide support to customers and projects like:

- Analysis of additives and NIAS in plastics and packaging
- Migration testing and analysis
- Long term stability studies
- Investigation of contaminants
- Raw material consistency
- Resin change procedures
- Advisory by our experts in packaging, plastics, REACH and food or pharma regulations

We also continuously keep track of >500 plastic additives and their status in EU 10/2011, FDA and REACH.



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Our liability services cover:

- Industry experts in polymers and additives
- Understanding the regulations
- Quantitative analysis of organic additives by GC or LC
- Quantitative analysis of inorganic additives by SEM/EDS
- Analysis of NIAS in polymers and packaging
- Migration analysis (EU/FDA)
- Food (EU/FDA), Reach and Pharma advisory
- Physical testing of the effect of additives
- Ageing / compatibility testing
- Compounding and extrusion



## Nanotechnology for energy-efficient buildings



### Norner member of SSTT



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We are proud to join SSTT (Scandinavian Society for Trenchless Technology).

SSTT members are owners of pipe-networks, suppliers, entrepreneurs and consultants which focus on a sustainable development of

community with minimum impact on environment and use of resources during installation, maintenance and renewal of critical infrastructure for our society.

Norner looks forward to contribute with exchange of experience and development of NoDig-solutions. Modern trenchless rehabilitation technologies utilize plastics to bring added value and save costs, time and

inconvenience during water & sewage network renewal.

Trenchless Technology involves the installation, replacement or renewal of underground utilities with minimum excavation and surface disruption. Often, trenchless techniques are the only viable construction option.





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FoAM BUILD, an EU-FP7-NMP funded research project, was established in 2013, to develop materials for improved insulation systems using nanotechnology based solutions.

There are over 200 million buildings in Europe. These account for 40 percent of our total energy consumption and 36 percent of the total CO<sub>2</sub> emissions in the region.

70 percent of the energy consumption in buildings is due to heating and cooling.

40 percent of the energy loss in many buildings is through the façade.

There is a large need for improved insulation to reduce energy consumption, costs and CO<sub>2</sub> emissions.

External insulation of buildings by so-called ETICS (External Thermal Insulation Composites System) is a widely used method in Europe.

This consists of prefabricated

components mounted directly on the facade. The insulation system is built up of two main components; insulation and decorative and protective surface in addition to components that provide adhesion and anchoring of the system to the facade.

A major challenge with the existing insulation materials is that improved insulating properties can only be achieved by increasing the insulation layer thickness. This increases the wall thickness and costs.

Another challenge is fire protection. Brominated bio-resistant flame retardants are mainly used, which represent a serious health and environmental risks to humans and wildlife.

A third challenge is the growth of fungi and algae. Good insulation gives colder outer walls. This gives more condensation on the façade and algae and fungi a good growth environment.

To counteract this, chemicals and biocides are used for washing facades or as additives in paints.

FoAM-BUILD will develop next generation External Thermal Insulation Composite Systems (ETICS) for new

builds and retrofitting applications.

The FoAM-BUILD project will develop thermoplastic particle foam using newly developed component and process set-ups. A nano-scaled structure will be developed for the particle foam cell morphology to achieve the targeted insulation behaviour; new polymer blends and nano-scaled nucleating agents in combination with a novel foaming process will be developed to realise the nano-cellular foam.

This development has the following objectives:

- Higher insulation properties than conventional insulation materials; 50% lower thermal conductivity.
- Cost and energy-efficient, industrial-scale processes that are used for EPS production.
- Recyclability (100% of the foam due to thermoplastic material).
- Same properties as conventional ETICS regarding insulation properties, mechanical resistance and stability, HSE etc.

2017 is the last project year. Therefore, launch of new exciting developments will be disclosed in the coming months. Follow the project news at [www.foambuild.eu](http://www.foambuild.eu)

## Success with no-dig project

Since 2013 Norner has assisted municipalities in Norway in evaluation of old and new Cured-In-Pipe linings.

Recently Norner took part in a unique project of Bærum municipality. Different commercial CIP-solutions were compared in a real life test-rig, exposing the linings for different challenges which may be present during installation.

The project revealed that testing of CIPP installations is highly recommended in order to confirm that the materials used comply with the site and engineering requirements.

The results and recommendations from the project was presented at the NoDig-conference in Oslo, May 19-20, 2016, by Dan Gjerstad, project manager at Bærum municipality.



## PIQL provides data storage for the coming generations



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We are living in an increasingly digitised world and together with our client Piql AS (Drammen, Norway), Norner has developed a solution to a growing concern regarding storage of digital data.

The amount of data in the world is doubling every two years and is estimated to reach >3 Trillion GB in 2022. 5% of it needs secure, long-term preservation.

The available storage mediums lack the durability, robustness and technology independence needed to secure that the data can be retrieved in the future. In fact, hard drives and magnetic tape, commonly used for preservation, were developed for back-ups and short-term data storage. To compensate for this weakness, the industry standard is to migrate data to newer storage medium every 3 to 5 years. Migration cost escalate as data

volume increases and the risk of data loss is considerable.

Piql has selected Norner as partner for testing and securing long term properties of the various components of the Piql Preservation System. The idea of this system is to enable data storage for 500 years. Such requirement calls for specially designed and verified stabiliser package in the polymer. Piql is building on the established preservation practice of microfilm, and has added digital technology and higher resolution.

Together we have developed a system with a life time of >500 years

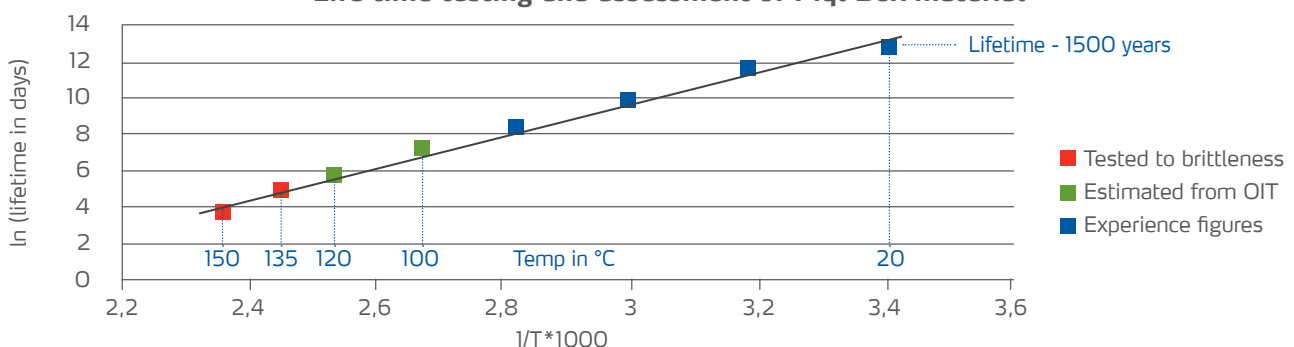
The Piql Preservation System converts photosensitive film into a digital storage medium, similar to what was done with analogue magnetic tapes many years ago. Any file can be written onto the film, including databases, text documents, images, and full motion pictures with sound. Together with film manufacturers, Piql has developed improved film where

photosensitive silver halide has been modified on nano-level to improve data density and reduce storage cost. The technology is unique and only one of this kind in the world.

The Polyester film comprise a gelatine layer containing the photosensitive silver. Like all materials, this structure is subject to degradation. Norner has tested and verified the longevity of the films by combining methods developed from the film and polymer industry.

The film reels are protected by an outer packaging, developed by Plasto AS together with Norner. Norner developed the PP material recipe compatible with the film avoiding negative impact on film degradation. Both the film and the packaging has been tested under controlled accelerated aging and results so far indicates a life time close to 1000 years in standardized storage conditions; 21°C, 50% RH. Norner has based the testing on the same principles as for pressure pipes like PE100.

Life time testing and assessment of Piql Box material







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OTAP for plastics and Kinder Egg – what on earth do they have in common? Actually more than you would imagine!

To make the chocolate you need to add emulsifiers to prevent fat separation, and in plastics you add emulsifiers to achieve antistatic- or anti-fog effect. Antioxidants are added to plastics to protect against degradation while dark chocolate contain its own antioxidant – flavonoids – protecting the ones who eat it. Food safety is a must for a Kinder egg and in many plastics applications.

However, the most obvious commonality lies in the fact that they both have 3-benefits-in-1.

With OTAP, we explore the experience of our industry experts to;

1. reduce costs spent on additives
  2. select the right additives with high purity
  3. reduce environmental footprint;
- for manufacturers of PE and PP.

Svein Jamtvedt and Harry Øysæd have been qualifying additives and additive manufacturers, as well as developing additive formulations to all polyolefin applications since the early 80'ies. Our experience from various production technologies has shown that there is significant room for improvements giving a very attractive business case for OTAP.

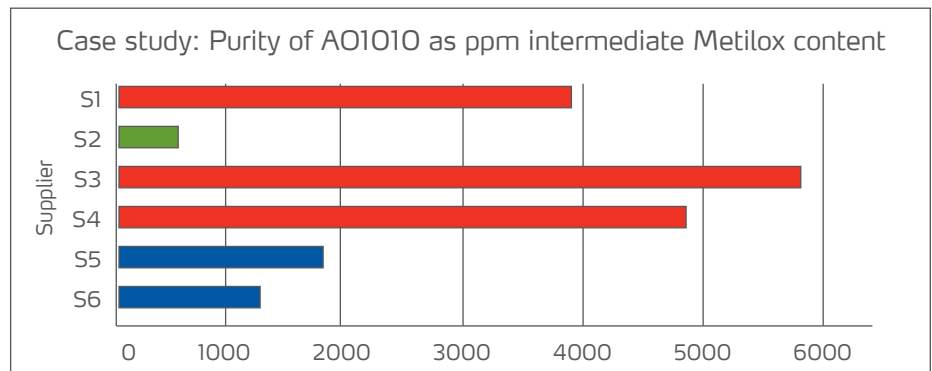
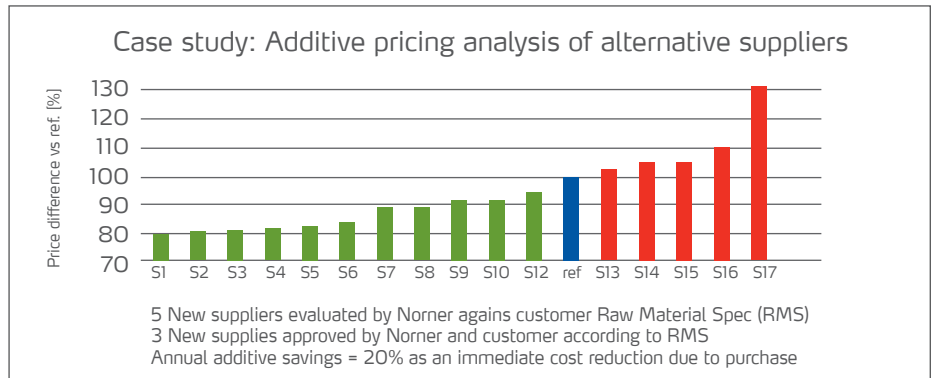
Norner work with three main elements to reduce the cost in OTAP projects;

- a. Qualifying new suppliers
- b. Challenging dosing level
- c. New additives combinations

The potential for cost reduction for a 300kta PP plant is in the range 0,6 – 1,2 MEUR/year

For a PE plant of similar size the cost reduction is about the half. With a typical OTAP project duration of 18 months and normal implementation

## OTAP - Optimisation of Total Additive Portfolio



rate of new additive formulations the IRR after 3 years will vary between 30 and 150% for a capacity of 300kta PP and 300kta PE.

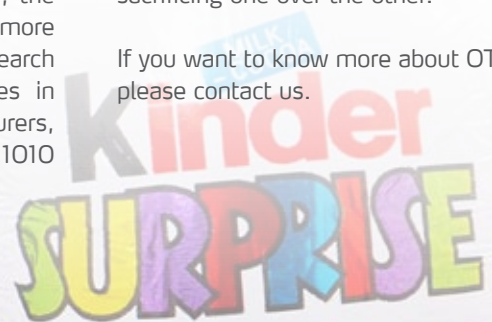
Consumers focus on food safety and human health is already a mega trend. At PEPP2016, Nestlé advocated stricter approval routines going beyond governmental regulations. Hence polymer manufacturers must have NIAS (Non Intentionally Added Substances) under control including what origins from additives. Norner has developed its own database, the "Norner Additive Guide", with more than 500 entries, and our research has shown significant differences in NIAS level between manufacturers, exemplified above with Metilox in 1010 from 6 different suppliers.

Norner gives also advice on which suppliers to use for special applications like medical, where high purity is a must.

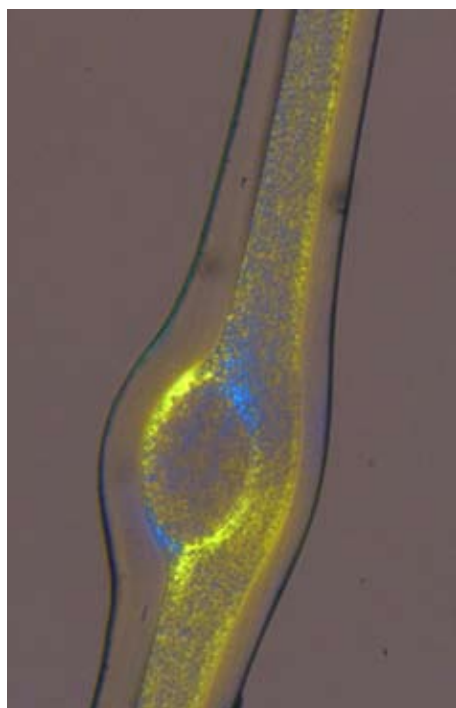
Our industry must also reduce the environmental impact from its activities. Too much additives is not sustainable. Products must be tuned to fit the purpose in each application.

The Kinderegg factor most often allow us to optimize both cost, purity and environmental impact without sacrificing one over the other.

If you want to know more about OTAP, please contact us.



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## At the back

### **Norner provides failure analysis to the packaging industry on a regular basis. Here is an example of problem solving for gels in co-extruded films**

The presence of gels is a classic challenge of film extrusion. Such imperfections in form of lumps in the films can be caused by many different factors.

Analysing a gel may involve the following analytical techniques:

- 1) Sample preparation by microtome cutting cross sections of the film and gel.
- 2) Microscopy analysis to determine in which layer the gel is located and visual investigation with different contrast techniques to understand its nature.
- 3) Melting the cut film under microscope to determine if the gel is melting.
- 4) SEM analysis with element screening to determine the composition of the gel, which allows proper identification of especially inorganic contaminations.
- 5) FTIR analysis under microscope of the gel to determine the chemical fingerprint and identification of the composition or if degraded.
- 6) Advanced polymer analysis of samples of gel by e.g. DSC or GPC is possible if the gel has a shape/size, which makes it possible to cut it out of the matrix.

The attached picture illustrates a case we analysed for a customer. Based on both good equipment and very capable personnel we can identify the type and cause of the gels.

The film is a three layer coextruded PE film.

- LDPE is used in the outer layers and LLDPE in the core layer.
- The gel is located in the LLDPE core layer.
- The gel is partly cross-linked.
- It is probably caused by thermal degradation during the extrusion process or by material in dead-zones in the extruder.

### Did you miss earlier editions?

You can access these earlier editions of Norner News through the following QR code or at <http://issuu.com/norner>



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