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NORNER NEWS

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Sustainability and Circular Economy

Cooperating with the Polymer Industry



norner™

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Dear reader

Normal is over. Norner is created on a vision – a vision to be The global market leader of Industrial R&D services in Polymers by exploring opportunities and discover Sustainable solutions.

I have enjoyed working with my highly competent colleagues and excellent customers worldwide for more than a year now, and I can assure that this vision is more alive than ever.

Recently I visited the "Arendalsuka" in Norway, which is a very large, annual, national arena where actors in politics, society and business meet with each other and people, for debate and formulation of politics for present and future.

I enjoyed, particularly, the discussions regarding environment and climate changes, where the Norwegian foreign minister, Ine Marie Eriksen Søreide, talked about how the shifts in politics, business and the environment, among others, affect the world today and in the future. "The future is more complex and unpredictable than ever. The biggest change to our normality will be the climate change which represents the greatest challenge of all time and a political conflict multiplier," she said.

Sustainable Solutions is one of the big global megatrends in our society, among our customers, and in our everyday life. Together with digitalization, this is where the drivers for future businesses will be, for our customers, and for Norner.

In 2015, both poor and rich countries adopted the 2030 Agenda for the United Nations Sustainable Development and its 17 Sustainable Development Goals. Public policy and industry must combine forces to tackle the complex challenges posed by these SDGs. By doing so, we can drive scalable, affordable and sustainable solutions.

Driving action on the SDGs is at the heart of our business in Norner, and we engaged our entire organization to define which of the SDG's where we have the highest impact. We contribute directly to "Innovation and infrastructure" (SDG #9) through innovations in our daily work towards sustainable solutions, and on "Responsible consumption" (SDG #12) when we advise our customers on how to improve production and resources. We help customer combat climate change and take "Climate action" (SDG #13) through development of recycling and circular economy solutions and we contribute significantly to "Life below water" (SDG #14) by our focus and effort to reduce plastic waste and marine littering.

We believe that there is a great future in plastics, a great sustainable future. Thus, in 2020 we will continue to actively prepare for the future, and we eagerly look forward to cooperating with our customers to explore sustainable solutions, together.

Navigating towards a new Normal. Again.

I hope you enjoy reading our customer magazine.

- Kjetil

3@Norner



Heidi Bryntesen
Hi, I am a Senior Engineer in the application centre and has broad contact with customers who I am very happy to help.



Ingeborg Wiik
Hi, as an Engineer in Norner laboratory, I am helping our customers and scientists with polymer developments and it's very exciting.



Lars Evensen
I am Business Development Director for polymer industry clients and I am very excited when we create good results for them.

New employees at Norner

Norner has finished another successful year. We have entered into several new research projects and achieved very good results in technology development with our customers. Our world-leading expertise in plastics will be central in solving the major global challenges in the near future of developing a circular economy and explore new sustainable solutions. Our team is continuously expanding and we are happy to welcome new employees:



Ida Marie Wold
Business Developer



Line Skåli
Senior Engineer



Toralf Hustveit
Senior Engineer



Hanne B. Olstad
Purchase



Kim Öberg Hed
Senior Researcher



Alireza Hassani
Researcher



Tina Kristiansen Voss
Researcher

ISO/IEC 17025

Norner is granted ISO/IEC 17025 accreditation for our protective coating testing. This is the most important quality standard for test laboratories internationally.

A laboratory's fulfilment of the requirement of ISO/IEC 17025 means the laboratory meets both the technical competence requirements and managing systems requirements that are necessary for it to consistently deliver technically valid tests and calibrations. The management systems requirements in ISO/IEC are written in language relevant to laboratory operation and operate generally in accordance with the principles of ISO 9001.

Advantages for our customers will be:

- Our equipment and instruments are regular checked by accredited and independent third party.
- Our test methods are according to latest versions of international standards.
- Accurate traceability throughout the complete testing.
- Overview over uncertainty budget related to testing.
- Skilled and approved personnel in all functions.
- Accredited management systems.
- Accredited reports.



A part of the team

Klaus Schöffel has started as Vice president R&D at Norner. Klaus has both relevant professional and broad industrial experience, which together with his recognition in management will contribute to further professional and strategic development for Norner.



Klaus Schöffel
Vice President R&D

"I have been following Norner and their development for some years and I am impressed. Therefore, I am very happy to be a part of this team and look forward to developing our research department further," says Klaus Schöffel.

New Laboratory Manager

Lene Rambekk is the new laboratory manager at Norner. She begins in a phase where several new investments are planned. Lene has already been responsible for investing in a new advanced electron microscope that makes Norner even better equipped to serve our industrial customers in materials technology.

"I have been in the industry for many years and was ready for new challenges. Norner is an exciting company, and for me this is a great opportunity to continue with management in combination with my profession. I am very happy to be part of the Norner team", says Lene Rambekk



Lene Rambekk
Laboratory Manager

Circular economy

Plastics play a key role in our everyday lives and their usage increases all the time. There are good reasons for this which include their durability, light weight, low cost and ability to protect. The most visible applications are in packaging and disposable products which ends up in our waste. Other product areas are more durable like automotive, infrastructure, electric and electronic goods, furniture and sport gear.



Ole Jan Myhre
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All these different applications require a wide range of performances and properties which can be modified in the polymerisation process or by additives and modifiers.

Recycling of plastics after its use has become a very important topic and need much further development in order to reach satisfactory quality.

Norner contributes significantly to this value chain of plastics in various ways and we are presenting these twelve examples of sustainable developments at this years K-exhibition where circular economy is our key focus area.



POLYMER



METALLOCENE CATALYST TECHNOLOGY

This innovation will contribute to high performance PE products at an improved cost level.



LAB REACTOR PILOT CENTRE

Our catalyst and polymerisation facilities are utilised by leading international technology providers.



TRIMODAL PE TECHNOLOGY

Bringing improved performance to applications like pipe, caps, bottles and films.

CONVERSION



POLYMER ADDITIVATION DEVELOPMENT CENTRE

Additive compounding, advanced testing and analytical facilities.



MATERIAL DURABILITY TEST CENTRE

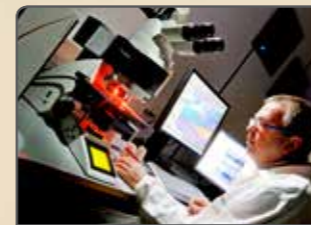
Heat stability, chemical resistance, UV-stability, weather resistance, ageing at high pressure and temperatures and more.



PROCESSING AND APPLICATION PILOT CENTRE

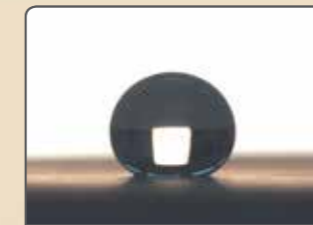
Injection moulding, thermoforming, film extrusion, blow moulding and application testing.

APPLICATION



PACKAGING BARRIER SIMULATORS

Flexible and reliable for fast assessment of food shelf life in your packaging.



NORNSLIP SURFACE TECHNOLOGY

With Nornslip you can reduce food waste and environmental impact.



PRODUCT INNOVATION CENTRE

Our customers are adding value to their business with our experts and facilities.

RECYCLING



RECYCLING PILOT CENTRE

Full service pilot centre for testing of recyclability, recycled materials and developing improvements.



RECYCLABLE MONO MATERIAL SOLUTIONS

Flexible packaging materials with improved recyclability is key for retail industry.



SOLVENT FLUSH TECHNOLOGY

We develop new technologies for improved quality of recycled materials.



Recycling pilot centre and qualification services



» Recycling can be described like the simplified figure.

As a response to the proposal from the European Union that 50% of all plastic packaging should be recycled by 2025¹, Norner has developed and are operating a Recycling pilot and qualification centre.



Morten Augestad
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Today, the quality and consistency of PCR are often inferior and prevent reaching EU/global recycling targets. However, the industry invests a lot of resources into PCR production capacity and they are taking initiatives to improve the offering.

There is a huge need to support these ongoing investments and developments with competence in polymers and application-oriented testing. Norner has worked with virgin polymer grade and application development for more than 40 years and has during the last years transferred this knowledge over to PCR and recycling.

WASHING & GRINDING

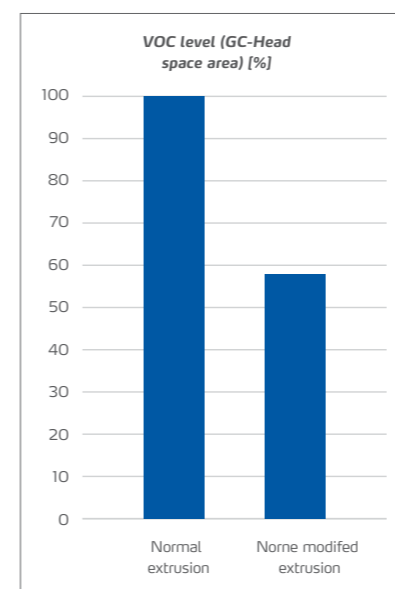
Packaging can have different shapes and sizes. Norner operate a grinder suitable for packaging as large as 800 mm and has an output capacity of up to 1000 kg/h. The machine is typically used for washed pre-plant trials of waste streams.

Norner also operate a series of grinders for small articles as seen in most consumer packaging.

PURIFICATION & GRANULATION

The grinded flakes need to be pelletized and Norner has upgraded a Coperion ZSK 26 compounding unit to become a unique tool for the evaluation of PCR/PIR flakes with a capacity up to 100 kg/h. To meet the requirements and ambitions of the industry, the machine is upgraded to be highly suited for development work as well as medium scale trials.

- Gravimetric feeding
- State of the art computerised monitoring and control system
- Liquid feeding of process aids
- Vacuum and venting unit
- Continuous melt filtration with tailored trial program



» Norner develops solvent flushing technology which shows promising reduction in PCR volatile content.



» Application testing of the quality and performance is key to the increased consumption of recycled materials.

APPLICATION VERIFICATION

The performance of recycled materials can be tested by a wide range of methods;

- Chemical characterisation (Migration, NIAS, impurities, additives, Molecular characteristics...)
- Performance according to ISO/ASTM test methods (Tensile properties, Charpy, Hot tack, puncture)
- Advanced processing and application performance.

...our tests show that some PCR grades has good properties and is qualified for advanced processing and application performance.

Norner operates and perform advanced and tailored application tests. This including processing performance trials by extrusion, extrusion blow moulding, injection moulding and more.

The produced foil, bottle or packaging are further tested for e.g. drop performance, top load, sealing and welding and/or ESCR, by using dedicated application test equipment specially designed for this purpose.

IMPLEMENTATION OF THE PCR

Many factors are important for a successful implementation of the PCR in new or existing applications. Most probably the most important is to have control of the waste source. PCR resins are not like virgin materials. Properties taken for granted in virgin materials will not have the same performance level in PCR. Projects done with partners at Norner has shown this very clearly. However, today's recycled materials are improved, and our tests shows that some PCR grades has good properties and is qualified for advanced processing and application performance.

¹) As described in "Communication from the Commission to the European Parliament, The Council, the European Economic and Social Committee and the Committee of the regions. A European Strategy for Plastics in a Circular Economy" Brussels 16.1.2018

Pilot and prototype thermoforming opportunities

Vacuum and thermoformed products are produced from sheet and the production volume within the packaging sector are often very large.



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Norner has invested in an automatic/manual thermoforming line with high flexibility. This has been done to meet the requirements from the market for initial tests in small scale or pilot runs. The line is meant for:

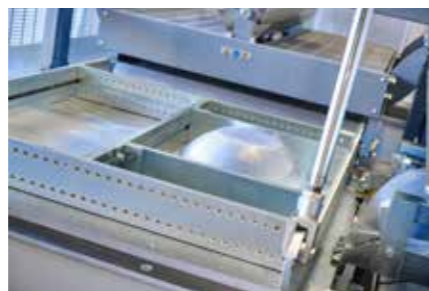
- Pilot production in small volume (< 1000 units)
- Prototype trials and development
- Material evaluations during development activity
- Pilot design evaluations in new/existing applications.
- Bench mark activity as part of material substitution work, claim handling / other
- Processing trials in HIPS, ABS, PE, PP, PET, PVC, PC, PMMA and recycled material

The line is delivered by Formech, a company specialized in small and medium sized lines. Norner has selected the model TF686 with the following features:

- 10" colour touch screen, real time adjustments, 1% heater increment control, Cycle View
- Pyrometer temperature control
- Reel Feed (automatic operation) or sheet feed up to 700 mm width and 350 mm dept of draw
- Sheet thickens up to 6 mm
- Plug Assist with Speed Regulator
- Ceramic Heaters with 16 Independently Controllable Heating Zones
- Pre-Stretch
- Positive and negative forming



» Norner has invested in an automatic/manual thermoforming line with high flexibility.



» Thermoforming of sheet.

The line goes hand-in-hand with our cast film, blown film or foil line and allow us to give a full offering within the thermoforming area.

The operation of the line is followed by chemical analysis, mechanical performance or application tests e.g. like top load, drop performance autoclave (retort) trials followed by our skilled colleagues.

Norner operate today a foil line where foils of 400mm width and thickness up to 1 mm can be produced. We also have on our investment plan a co-ex foil line for up to 5 layer structure meant for the market where high barrier performance is needed.

We welcome you to Norner to perform your trails on the new line.

Caps and closures in a circular economy

Tremendous changes are ongoing within the caps and closures application areas for many reasons. The ambition for a sustainable future and a circular economy is the main driver.



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These developments include

Beverage caps:

- New design where "non detachable caps" EU target is a driver for design change
- Introduction of new high performing cap raw materials where current application test scheme is insufficient

Design caps for liquid food, cosmetics and chemicals:

- Introduction of Post-Consumer Recyclate
- Design driven changes for a more sustainable cap solution

To contribute to this important future development a full application performance centre C&C has been developed by Norner.

For **beverage caps** we produce caps for PC01810 bottle finish on our high-performance injection moulding machine. During production processing performance, cycle potential and energy consumption can be measured. The caps are then tested in a high capacity test set up that include:

- Closure dimensions
- Cap dooming under pressure (i.e. 6 bar)
- Leakage tests like Secure seal test or CO2 retention
- Environmental stress crack of cap (ESCR) under relevant pressure.

For the **food, cosmetics and chemical**, we produce a "flip-top" cap in a 4-cavity mould. The flip-top has different surface finish in the cavities for supporting the development in a design driven market area. The processing trial includes de-moulding behav-



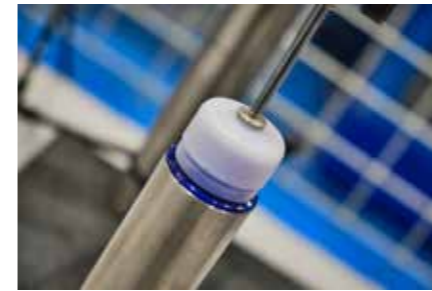
» Hinge testing of a flip top cap.

our, pressure requirements and flow characteristics, odour released during production and more. The produced caps are tested by using several tests and methods that include:

- Closure dimensions
- Hinge Torque strength
- Hinge Tensile test
- Hinge fatigue test
- Response of Colour MB in performance

Tests done on the products produced by PCR materials show high variations in performance and processing. So the material selection for a cap can be demanding and should be supported with well documented trials.

Welcome to Norner C&C application centre.



» Beverage caps testing.

Exploring Microplastics

Plastic debris found in all major oceans and plastic pollution, on macro- and micro-level, have attracted considerable public attention in recent years. The growing concern from the public through the high media attention has now put plastic pollution high on the policy agenda.



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Marine litter is a result of improper disposal of waste items that are either directly or indirectly transferred to the seas and oceans.

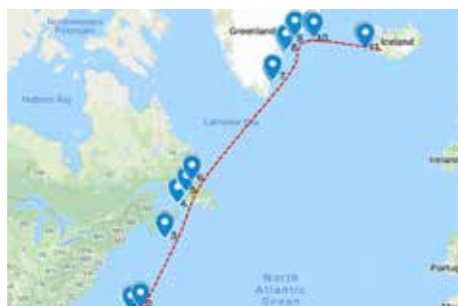
Plastic in the environment is exposed to weathering forces such as UV light, wave action and colonization by biota, leading to fragmentation, polymer degradation and particle surface modifications that change its density, size distribution and environmental fate. Due to fragmentation and degradation plastic products will form microplastics (< 5 mm in size) and come from a variety of sources, including fisheries, products and textiles (use and breakdown), agriculture, industry, waste, litter and others. A growing concern has also been raised with nanoplastics, but knowledge still is limited.

The amount of research of micro- and nanoplastics has been growing exponentially, but knowledge is not growing at the same rate. Some of the evidence remains uncertain and

it is by its nature and complex, due to differences in size, shape, chemical additives, concentrations, measurements, fates, unknowns, human factors, media influences, actions and behaviours.

The best available knowledge concludes that, while ecological risks are very rare at present for microplastics pollution, the risk may be widespread within a century if future emissions to the environment remain constant or increase. Little is known with respect to the human health risks of micro- and nanoplastics, and what is known is surrounded by considerable uncertainty. However, according to the Evidence Review Report provided by SAPEA, part of the European Commission's Scientific Advice Mechanism, there is no evidence of widespread risk to human health at present.

The levels of plastic pollution decrease away from areas of high human impact and commercial activity, thereby assumed to be decreasing towards the polar latitudes, but limited knowledge exists due to seasonal restriction and the expense and challenges involved in doing research in such remote areas.



» The Arctic Expedition sailed from the Bahamas to Bermuda - Nova Scotia - Newfoundland - Labrador - Greenland - Iceland and back to Norway.



» The Arctic Expedition trawled in 2018 for macro- and microplastics over a distance more than 5000 nautical miles.

In 2018, Norner supported S/Y Fairwinds on the "Arctic Expedition 2018", that sailed from the Bahamas to Bermuda - Nova Scotia - Newfoundland - Labrador - Greenland - Iceland and back to Norway. The Arctic Expedition trawled for macro- and microplastics over a distance more than 5000 nautical miles, and collected samples on 11 locations, to further build knowledge of macro- and microplastics in the oceans.

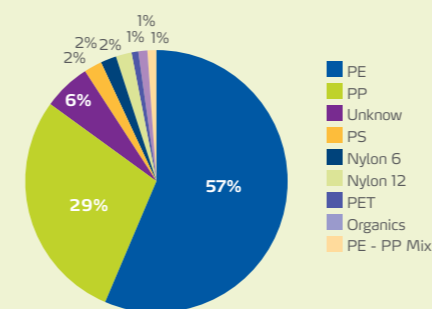
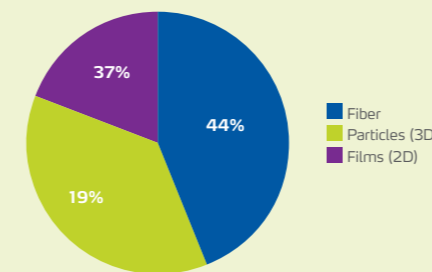
In 2019, Norner initiated a M.Sc-thesis and started own investigations to characterise real-life sea-surface microplastics that were sampled during the Arctic Expedition.

Close to 400 particles from the 11 locations in the North Atlantic Ocean was analysed using ATR FT-IR and was verified by analysing 50 of the particles by pyrolysis-GC/MS.

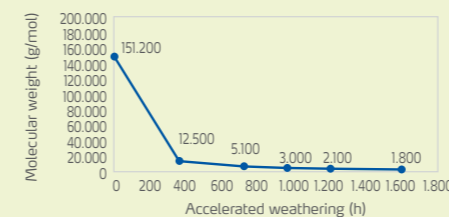
An average of 0.025 particles per m³ was found confirming that the concentration of plastic pollution is still low, but that traces of human misbehaviour is widespread.

The majority of the samples were fibre (44%) and films (37%).

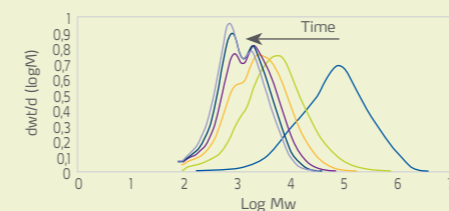
94% of the particles were identified as synthetic polymers, where PE (57%) and PP (29%) showed to be the most abundant types of plastics found.



Changes in molecular weight distribution of LLDPE due to weathering



All intervals for power samples 1-1



» Molecular weight distribution curves of PE (sample #1) weathered for different intervals.

In order to understand the degradation speed and mechanisms, artificial weathering was conducted on PE material where daylight was simulated. The accelerated aging of the plastic samples in UV-chamber bring the chemical changes in the polymer backbone due to partial degradation. In specific, UV-weathering in polyolefins leads to introduction of carbonyl functionality introducing polarity to the polymer, which can be observed by FTIR. GPC analysis indicated a significant decrease in molecular weight during the initial periods of weathering, which is relevant when discussing accumulation of plastics in the environment and the potential transformation of microplastics to nanoplastics.

It was observed that e.g. LLDPE films degrades very fast, and that the molecular weight, Mw (g/mol), of a commercial bread bag was reduced from 93800 to 2000 within a simulated time period of less than 2 years when exposed to sunlight. Such low molecular weights are what commonly is observed in synthetic and natural waxes. These findings illustrates the complexity of effects when addressing marine littering and plastic pollution.

Another complicating fact with respect to understand the effects of microplastics is that most experimental designs on microplastics research do not allow plastic-specific effects to be distinguished from those caused by other particles, such as clay and cellulose, which are naturally ubiquitous in the environment. Most of today's experimental studies is the assumption that the aquatic environment is somehow "particle-free". Such approach has serious implications for making relevant conclusions of the effects of microplastics on organisms as no single effect can be ascribed exclusively to the presence of microplastics, if it remains unknown whether similar responses can be induced by nonedible natural particles of similar size and shape.

To understand environmental risks associated with their occurrence and to address specific effects of microplastics, comprehensive polymer knowledge from the plastics industry needs to be more involved in the research of micro- and nanoplastics. Without a proper understanding of the plastics being studied and without adequate controls at natural occurring reference particles, it is likely that amount of research of microplastics and nanoplastics will continue to grow exponentially, but relevant knowledge will not.

The complexity of polymer materials poses particular challenges as various factors, such as shape, size, physicochemical properties, leachates, etc., need to be considered. What is commonly used today in micro- and nanoplastics research is commercially available plastics particles which is not representative to what is to found in the environment.

Norner has the possibility to provide tailor-made (e.g. isotope-labeled) polymers and particles with different level of degradation and sizes to contribute to better understanding of the fate and risks with respect to microplastics. Our target is that Norner's polymer expertise in the plastic value chain will be helpful in transferring new insights, directly towards consumers, industry and public bodies, which all play crucial roles in resolving the challenges of littering.

What remains clear however, is that improper disposal of waste needs to stop and that plastics are too valuable material to be discarded in the nature and lost for recycling and re-use.



Beach Cleaning Day

Coastal Clean-up engages people around the world to remove trash from the world's beaches and waterways, identify the sources of debris and change the behaviours.

» By engaging in clean-up actions, we contribute to increased awareness as well as making it possible to remove large amounts of litter from the marine environment.

Norner believes that we all can be a part of the solutions to stop marine littering.

By taking part in the beach cleaning we can contribute to a cleaner environment by removing waste from the marine environment and preventing waste and pollution from entering into the marine environment.

Current estimations are that 8 million tons of plastics end up in the ocean every year. The number is overwhelming. But what if we look at the power of individual human efforts? The world is soon reaching a global population of 8 billion people. Broken down, the plastic littering challenge is 1 kg per person. At the Norner Beach Cleaning Days, we collect on average 10 kg per person in less than two hours.

Doing something small, can make a great difference.

We also value the increase in knowledge of marine littering through our findings, but most importantly increase awareness about the problem of marine littering amongst private citizens and businesses as well as in the public sector, which contribute to the prevention of marine littering in the future.

In order to reach the magnitude of the sustainability challenges the world is facing, we believe also doing something small for something great makes a difference. And greatest of all is the ocean.

NORNER'S CONTRIBUTION

On April 29th, we arranged, for the fourth year, in a row the Norner Beach Cleaning Day and cleaned 4 recreational areas in the scenic Eidangerfjord in Telemark County.

Although many of the beaches looked clean at first sight, we found a significant amount of trash by searching the surrounding areas, where currents have moved marine debris of time to shore.



Thor Kamfjord
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Marine litter pays no respect to geographical boundaries, and we believe we share a common responsibility to keep our lakes, waterways and oceans clean. The key to achieving this goal is collaboration both on a local level and on a global level.

The coastal clean-up has an immediate and tangible impact on the health of our ocean. These actions remove thousands of tons of trash from beaches and waterways worldwide while fostering awareness of the marine debris issue and a sense

of stewardship for one of our planet's greatest natural resources.

By engaging in clean-up actions, we contribute to increased awareness as



well as making it possible to remove large amounts of litter from the marine environment.

Every year large amounts of waste enter the ocean and end up along the coast on islands, beaches, on the surface of the ocean, in the water column and on the seafloor. Lakes and waterways are also affected. To combat this problem, the world must focus on litter prevention as well as on clean-up actions.

Taking part in clean-up actions often makes a lasting impact, and picking litter is an eye-opener that very often contributes to lasting behaviour change ending littering. Ultimately, this is what we are aiming for.





Norner Supports Operation Clean Sweep®

Everywhere we look, we find plastics. They are an indispensable part of our world and our modern way of life wouldn't be possible without them. However, plastics often end up littering our environment, especially our seas.

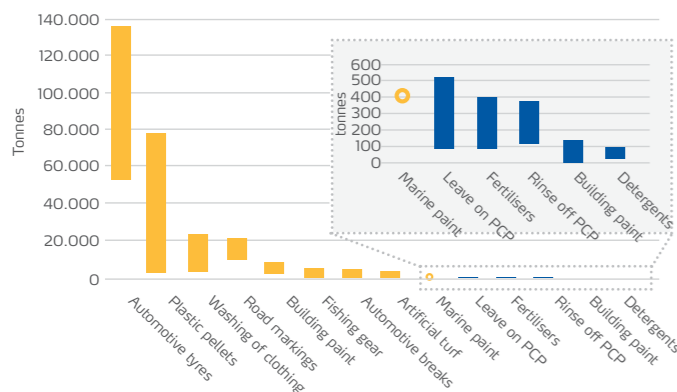


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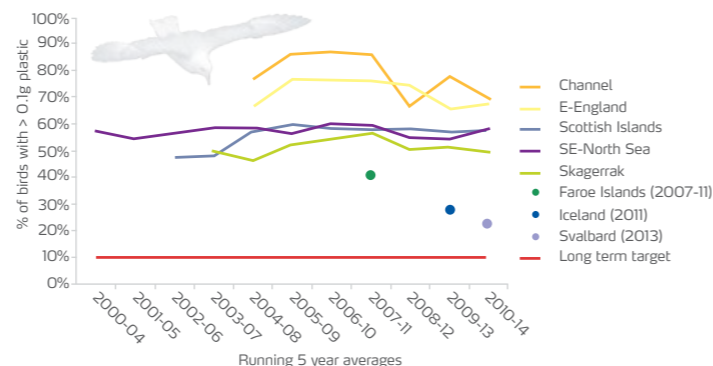
Norner considers any plastic leakage into the environment as unacceptable. Spilled plastic raw materials – pellets, flakes and powder – are amongst the largest sources of primary microplastics in the environment. These can end up in soils, waterways and eventually the ocean, contributing to global microplastic pollution. Since the plastics industry (and its value chain) is producing and handling these pellets until their conversion into a final product, it has direct control over their management and containment within its facilities.

Marine litter has received a lot of attention recently and several programmes have been implemented worldwide to combat plastic pollution. Yet, there is one aspect of litter that the plastics industry is solely responsible for. Plastic pellets, flakes and powder can be accidentally spilled along all stages of the plastics value chain and enter terrestrial or marine environments, with severe environmental impacts.

A 2018 study by Eunomia modelled the annual emissions of microplastics into surface waters in the EU, highlighting the three main sources: tyre abrasion, industrial plastic pellet loss and washing of synthetic textiles (Fig. 1). Plastic pellets are estimated to be the second largest source of microplastics entering the aquatic environment in the EU with an annual median emission of 41,000 tonnes (ranging from 3,000 to 78,000 tonnes).



» Fig 1: Eunomia and Amec Foster Wheeler modelling of annual emissions of microplastics to surface waters in the EU2.



» Fig. 2: Running 5-year averages since 2000 showing the percentage of fulmars (%) found with more than 0.1 g of plastics in their stomachs.

OSPAR has a biological monitoring programme on the quantity and mass of plastics found in the stomachs of northern fulmars. Using this programme as an environmental quality indicator for the North Sea, OSPAR set a long-term target of having less than 10% of northern fulmars with over 0.1 g of plastic in their stomachs. However, this target is yet to be reached. According to the latest assessment, 58% of birds contained over 0.1 g of plastic (Fig. 2). The study showed that more than half of the examined fulmars contained plastic pellets in their stomach, amongst other ingested items, with an average of 3.1 pellets (0.07 g) per bird. Therefore, to meet the OSPAR long-term target, greater efforts to combat plastic pollution and improve pellet containment need to be made.

Norner has committed to assist with the prevention of industrial plastic materials by signing on as a supporting member of Operation Clean Sweep® (OCS) and are working together with the Norwegian Retailers'

Environmental Fund to encourage more of the Norwegian plastic industry to join the programme and commit to a Zero Pellet Loss target.

Operation Clean Sweep is an international programme designed to prevent the loss of plastic pellets, flakes and powder into the environment by providing plastics industry employees with effective tools to contain them.

OCS was created taking into consideration all levels of the plastics industry; resin producers, converters, transporters and recyclers, along with the different equipment that these companies may use. Within Europe, OCS is supported by several national plastics associations with PlasticsEurope, the European association of plastic manufactures, as the major host. OCS has already been implemented by more than 500 European companies and associations along the plastics value chain.

Joining OCS is a simple step in empowering the plastic industry to become more environmentally, socially and economically sustainable. We encourage all our clients to visit www.opcleansweep.eu and sign the pledge. After signing up, access to all OCS tools and materials will be available online. These include the OCS manual and customizable checklists for both employees and managers, which will make implementation effective with measures specific to own needs.

Norner is committed to an environment free from plastic pellets, flakes and powder. With the support of companies such as our clients and partners in the plastic value chain we can make a real difference and combat the plastic pollution. Let's all be a part of the solution – and not the problem!

Pipelife becomes the first Norwegian pipe producer to join Operation Clean Sweep

- The plastics industry takes responsibility for preventing plastic from polluting our oceans. Pipelife wants to be responsible for ensuring that our production process does not pollute our local environment, and that our raw materials and products are used properly and do not go astray.

Being an environmentally friendly and sustainable industrial company is an important goal and vision for us. We have a long tradition of

ensuring that all our raw materials go to the production of essential and environmentally friendly products for the community's infrastructure, so that plastic raw materials do not go astray and end in the nature.

We follow up the objectives in practice by, for example by keeping environmental accounts for the factories in Surnadal and at Stathelle since 2010, so that both customers, users and ourselves gain insight into how we work for a lower carbon footprint. We, as the only Norwegian plastic pipe manufacturer, have developed and published Approved Environmental Declarations (EPD) on four product groups.

We are delighted - and proud to be - part of the global initiative "Operation Clean Sweep" and encourage more Norwegian plastic industry companies to do the same!



PIPELIFE NORWAY

- Norway's largest manufacturer and supplier of plastic pipe systems
- Almost all production takes place in Norway, at factories in Surnadal, at Stathelle and Ringebu.
- Turnover more than NOK 1 billion and approx 250 employees.
- Pipelife uses around 40000 tonnes of plastic raw material annually in its production.
- Pipelife Norge AS is part of the Pipelife Group network, which is wholly owned by the Austrian Wienerberger Group.

OPERATION CLEAN SWEEP

- "Operation Clean Sweep" is a voluntary program created by the plastics industry to prevent, among other things, plastic pellets or "mermaid tears" from falling into the nature.
- Through participation, the plastic industry gain access to methodology, guidance material and proposals for measures that own companies ensure that plastic raw materials do not end in nature.



Norner supports Ocean Sun towards a clean energy future!

» One example of Ocean Sun's floating solar system: Photo: Ocean Sun

There is a high focus today on producing clean energy made from renewable sources, and Ocean Sun is one company we are supporting in this segment. The wind energy sector is divided into turbines made for on-shore and turbines made for off-shore conditions. When thinking of energy produced by solar cells, most of us think of land based solar module plants or solar cell modules placed on the roofs or facades of houses, cabins or other industry buildings. But did you also know that solar cells can be placed off-shore? They can!



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Ocean Sun has developed a technology that will enable large-scale solar development on coastal seawater, lakes and reservoirs and they have patented the technology in several countries around the world. 1234

Ocean Sun's vision is to provide the technology that makes clean energy

production the cheapest alternative to large populations around the world. The company was established by Børge Bjørneklett, Øyvind Rohn and Arnt Emil Ingulstad in 2016.

Ocean Sun has successfully tested a prototype off-shore in Western Norway since April 2017.

Test facilities have also been built on a fish farm outside Singapore and on a water power reservoir at the Philippines for SN Power. Recently a commercial contract was signed with Statkraft Albania for the delivery of a floating solar plant with a maximum capacity of 2 MW at the Banja reservoir in Albania.

Land-based solar power plants require large areas with abundant sun. There is however a limited number of suitable sites located near the population centres where the power will be used. Floating solar cells create major opportunities to renewable energy production around the world. They can be used in areas which are seen upon as not very productive, such as in the open ocean, ponds or lakes.

Ocean Sun's floating solar system are built up of a thin polymer membrane carrying the solar cell modules. One benefit of attaching the solar cell modules directly on the polymer

membrane is to lower the temperature in the solar cells. By lowering the operating cell temperature in the solar modules, the system efficiency may increase as much as 15% compared to standard land-based installations.

Norner supports Ocean Sun and their suppliers in selecting, developing and testing the optimal polymer membrane solution. The membrane needs to be strong enough to carry the loads of the modules and to be able to withstand the movement of the waves. The membrane will be exposed to sun light, water, heat and

marine algae which are factors that will have an important impact on the lifetime of the membranes. A strong, weather resistant, thin membrane with more than 20 years lifetime is the target.

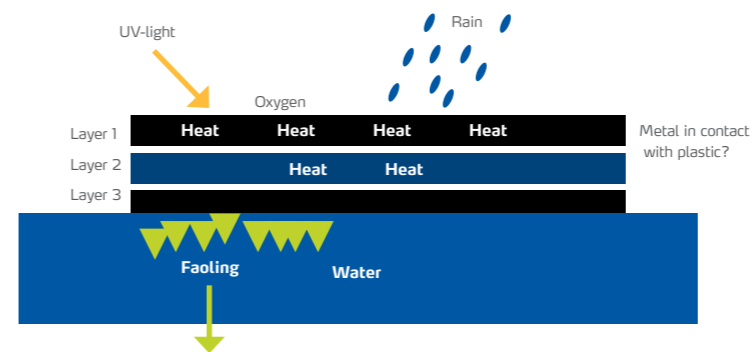
Norner has a significant polymer knowledge and know-how on how to formulate the most optimum polymer solution for a product that needs 20 years of lifetime or longer. The manufacturers of the membrane use their own in-house and secret formulations, but a good dialog on how to be able to reach the target of 20 years lifetime has been obtained by Norner's support.

Another important aspect of the collaboration with Ocean Sun is the testing facilities that Norner offers. The mechanical properties of the membranes need to be good enough to carry the loads of the solar cells, the wind and waves and also that people walk on the membranes during mounting and inspection.

Polymers that are exposed to sun, heat and water will degrade during time, and it is very important to test and prove that the mechanical properties of the membrane is sufficient even after long term use.

Norner offers environmentally durability testing by accelerated ageing, and our Weather-O-meters, mechanical test facilities along with material characterization are being used in the present collaboration.

The collaboration with Ocean Sun increases Norner's experience within materials for the renewable energy, and we look forward to continued support of the exciting products that Ocean Sun deliver.



» UV-light, rain, water, heat and marine algae are factors that affect the lifetime of the polymer membranes.



» Floating solar cell modules mounted on a polymer membrane: Photo: Ocean Sun

Extending the service life of polypropylene-random copolymers in contact with extractive media

SONGWON Industrial Group is the second largest manufacturer of polymer stabilizers in the world.



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SONGWON and Norner started a cooperation within polymer additive related work already in September 2007, the same month Norner was established and SONGWON was thereby one of the first customers of Norner. The early start of the co-operation was based on good relationship built up over years prior to establishing Norner as an independent service provider with the plastics industry.

For more than 20 years, polypropylene-random copolymers (PP-R) have been one of the materials of choice for producing plastic pipes for hot- and cold-water sanitary applications.

“Since many years Norner is an important partner for SONGWON in the polymer stabilizer field.”

says Elena Scaltritti, Leader Division Industrial Chemicals.

PP-R pipes need to go through intensive testing before they can be approved for installation. One of these



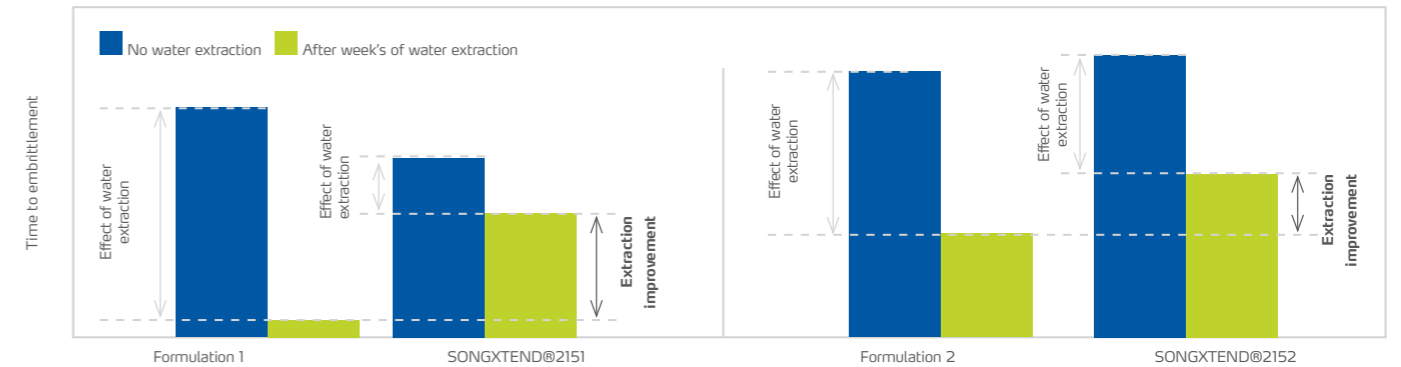
» The new additive concepts developed by Norner and SONGWON show extended service life for PP based pipes used in extractive media.

tests assesses the durability of the pipe. A sample is immersed in a hot-water bath for a given period of time, then oven aged to monitor embrittlement. To be able to withstand these severe testing conditions, PP-R needs to be suitably stabilized. Stabilization packages have traditionally been based on phenolic antioxidants.

Since 2013 SONGWON has offered its SONGXTEND® product line. The SONGXTEND® product family offers

innovative stabilization packages that solve a number of key issues encountered during processing, conversion and the end use life cycle of polyolefins. Several SONGXTEND® products are today commercially available. Together with Norner, SONGWON recently developed two SONGXTEND® solutions for long-term thermal stabilization of PP-R pipe resins that are more cost-efficient than the standard systems:

- SONGXTEND® 2151 stabilizer
- SONGXTEND® 2152 stabilizer



» Extended service life of PP achieved with SONGXTEND® 2151 in extractive applications.

» Extended service life of PP achieved with SONGXTEND® 2152 in extractive applications.

“Their knowhow and expertise bring a great contribution on projects like extending the service life of polymers.”

Besides improved cost efficiency, the benefits of these SONGXTEND® solutions include:

- enhanced processability
- excellent product consistency
- high temperature resistance
- minimal influence on taste & odor

The performance advantages of SONGXTEND® 2151 stabilizer and SONGXTEND® 2152 stabilizer are demonstrated in the above figures.

The key advantages of plastic pipes based on PP-R are light weight, fast and reliable weld jointing, and corrosion resistance.



SONGWON

SONGWON, which was founded in 1965 and is headquartered in Ulsan, South Korea, is a leader in the development, production and supply of additives and specialty chemicals. The second largest manufacturer of polymer stabilizers worldwide, SONGWON Industrial Group operates companies all over the world,

offering the combined benefits of a global framework and readily accessible local organizations. Dedicated experts work closely together with customers to develop tailor-made solutions that meet individual requirements.

For further information, please go to: www.songwon.com.

Failures in Rotational moulding

Rotational moulding has been a key area at Norner for more than 25 years and we have helped customer overcome a variety of problems during this time.

Technology, machines, materials and operators are getting better, but problems still occur. At the same time the requirements and demands of the product and application are increasing and gives new challenges for the industry.

In the previous magazine, we presented 5 typical RM product and design problems and in this article we will discuss 5 typical problems related to material and processing aspects.

SELECTING THE RIGHT GRADE

PE materials are mainly classified according to their density and Melt Flow Rate (MFR) but performance is also affected by changing the comonomer and catalyst system in PE production.

The stiffness will increase with higher density and increasing MFR will give better flow properties. Impact strength and environmental stress crack resistance (ESCR) will increase with a lower density and MFR. Furthermore, the impact and ESCR will be improved if the PE is produced with hexene (C6) or octene (C8) comonomer compared to butene (C4).

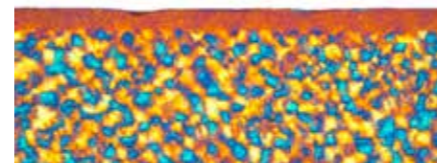
This 800 l fuel tank has a crack in the curved corner. Our investigations showed poor material distribution, sintering and bubbles.

The customer changed to a higher MFR material. This solved the problems related to material distribution and sintering. But now the tank broke due to lower physical properties.

How to solve it?

When choosing the optimum resin for a product, we need to have a full specification. Additionally, we must optimize the processing conditions

to secure optimum properties of the chosen material.



PROCESSING

A last but important reason why products are failing in service are related to processing. The attached image illustrates the problem very well.

The rotomoulding process is a unique production method for plastics. All the different Steps in the process, heating, sintering, densification and cooling are taking place on the inside of the mould.

Key process parameters are:

- oven temperature and time
- weight of material/product
- rotation speed and ratio
- cooling time and medium
- demoulding temperature

Key material and mould variables:

- particle size and distribution



- melt flow rate and density
- mould material
- mould shape and design
- efficiency of the oven and cooling

The time in the oven to heat up the polymer in the mould until all material has melted is critical and influenced by the above parameters. We recommend a target PIAT (Peak Internal Temperature) of 220°C. Alternatively a longer oven time. A typical problem if this is not obtained is poor sintering and bubbles which result in mechanical failures under stress.

How to solve it?

A proactive approach to the processing parameters in order that the material gets properly melted and ensure good quality control and inspection. Monitor and control both time and temperature in the process. Use temperature of the mould/material as the key parameter for controlling the process.

INHOMOGENEITY

Inhomogeneity is similar to contamination, but this problem has often a relatively low focus at RM producers. This can occur in different ways, but the most common problem is with black materials.

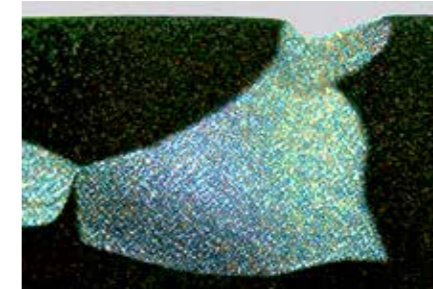
When making a black compound, it is important to achieve good distribution of the CB. If not, the different particles will have different density which gives an uneven inner surface. The same can occur with other pigments.

We have also seen inhomogeneity in natural material. This can happen during production or grinding where

particles with different density or grade are mixed together. Inhomogeneity is easily visible in the product as a poor inner surface.

The pictures show different structures caused by inhomogeneity

1. Mix of materials with different density



2. Mix of natural and black material
3. Particles With different CB content

This should be avoided, because it can influence the physical properties and give product warpage due to different crystallisation.

How to solve it?

When you are experiencing this kind of surfaces, the materials should undergo a quality check. The inhomogeneity is normally created during the production of the material, so this should be part of supplier approval procedures. In addition, keeping good internal procedures is important.

PIGMENTATION

When materials for RM shall be coloured, the pigmentation can be made in different ways:

- Compounding
- Dry mixing
- Compound mixed with powder

And the pigments can be organic or inorganic.

Organic pigments are clean, strong and will give a bright colour. These are also less toxic than in-organic pigments but more expensive, difficult to disperse and tend to migrate out of the product.

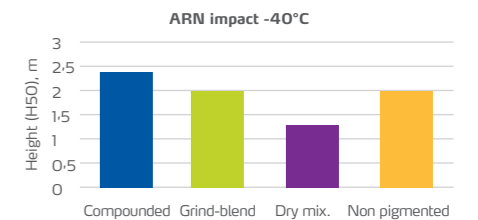
In-organic pigments have better heat and UV stability and are easier to disperse. They have also lower cost and does not migrate but have less

colour brightness and can be more toxic. This may cause a problem with water and food contact approvals.

The pigments and how these are added will influence both processing parameters and the final properties of the product.

- Poor dispersion and product failures.
- The choice of pigment can influence on oven time.
- Reduce the UV stability.
- Variation in dimensions due to shrinkage and warpage.

The histogram shows the result of ARM impact strength testing of the different pigmentation techniques into the same base resin. The basis for the test is a natural material processed at optimum processing conditions.



This demonstrates that a reduction of mechanical properties of 50% or more if pigments are not well dispersed.

How to solve it?

The best solution is to use compounded material, which is better for:

- processing
- dispersion of pigment
- aesthetics
- mechanical properties
- UV performance
- control of warpage / distortion

CONTAMINATION

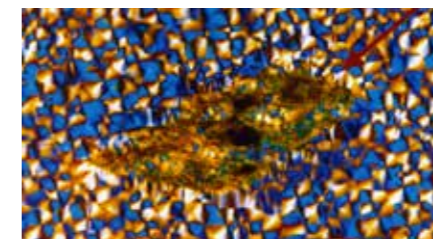
Materials can get contaminated with foreign material in many ways. Therefore, it is important for everyone in the value chain to have good procedures to prevent this. Since the RM process will not homogenise, only sinter the material, contaminations are very critical and one of the main reasons for product failures.

Contamination can happen at different stages:

- Silo at the producer
- Transportation of material
- From the grinder
- When doing dry mixing
- Cleaning of the mould

The most important factor is to keep the factory tidy and clean and have awareness.

The picture show a case where particles with different colour was found in the product. Investigations by microscope and FTIR identified the material to be polyamide.



Then we had to ask; where can this come from? The material producer did not produce Polyamide and the customer did not use it either. However, we found that the grinder used brushes during cleaning of the mill made of Polyamide. Parts of the brush had loosened during cleaning and contaminated the material.

How to solve it?

The contamination can be investigated by microscopy which helps you to find the root cause. Other analyses may also be required. Based on the outcome, an open minded search for possible sources must be done.



FuturePack project studies recycling

Growing consumer demand and legislative requirements drives innovation in recycled plastics on the EU market in a number of applications. Yet recycling rates are too low and the quality of recycled materials are generally lower than virgin.



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Norner Research AS leads the large research project FuturePack, comprising altogether 13 industrial partners, R&D institutions and NGO's. FuturePack will develop new technologies for renewable plastics and demonstrate novel solutions to design for recycling and improved recycling of plastics packaging. In this article we will give some examples of the project results.

Plastics are important packaging materials where low weight/volume is combined with excellent protective properties for food in transport, retail and at consumers. Better protection is a key contribution to prevent food waste. However, future plastics pack-

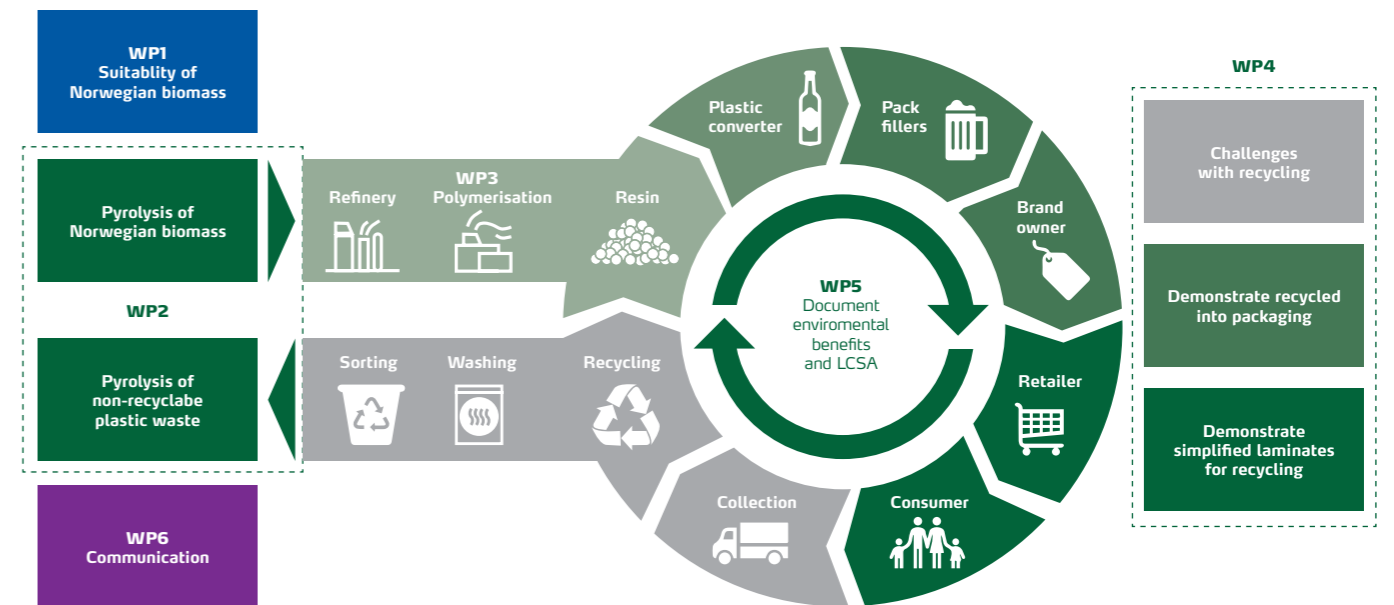
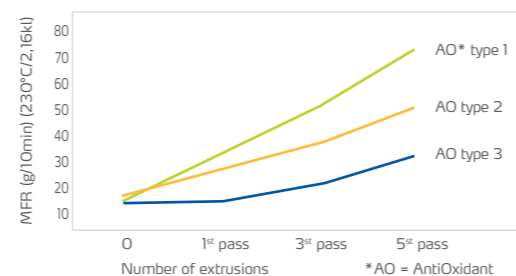
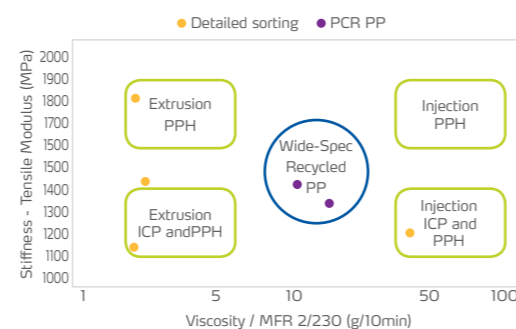
aging need to become even more sustainable through increased share of biobased and recycled materials.

This will contribute to reduced CO2 emissions, better resource utilisation and reduced littering. These topics are central to the FuturePack project and to the project partners. The Norwegian industry partners are Bama, BEWi, Elopak, Grønytt Punkt, Mills, Norgesgruppen, Nortura, Orkla, ROAF and Tine, representing various parts of the value chain for food production, packaging and recycling. The participating R&D institutes, in addition to Norner Research, are Nofima, RISE PFI, Østfoldforskning and NTNU IKP. Together, these institutes hold key competence in biomass conversion to building blocks and polymers, polymer technology, plastics processing, food packaging and plastics recycling.

RIGID PACKAGING CASE STUDY

Post-consumer recycled materials are in practice a blend of different grades. Norner has carried out two collection campaigns for rigid plastic packaging of household waste from employees. The rigid plastics packaging waste was sorted into the main polymer types, PP, PET, PE, PS and others. PP packaging

constituted almost 40% and the largest fraction. This was further detailed sorted by Norner's polymer experts into fractions comprising injection moulded packaging, thermoformed packaging, bottles and caps & closures. Normally the packaging producers will use different grades of PP with different mechanical properties and viscosities for these applications. We have analysed



» Figure - The project is organised into work packages and has a duration of four years.

and tested the fractions and compared this to commercially available PCR materials.

The individual fractions were recycled by washing, drying, shredding and pelletising. These finely sorted, recycled fractions had mechanical properties close to the respective virgin materials. In contrast, commercial recycled post-consumer materials used for reference were wide-spec and did not meet the specification requirements for the original applications. This study demonstrates that improved sorting of post-consumer waste is a key factor in the future to recycling success and a prerequisite to enable recycling back into similar packaging application.

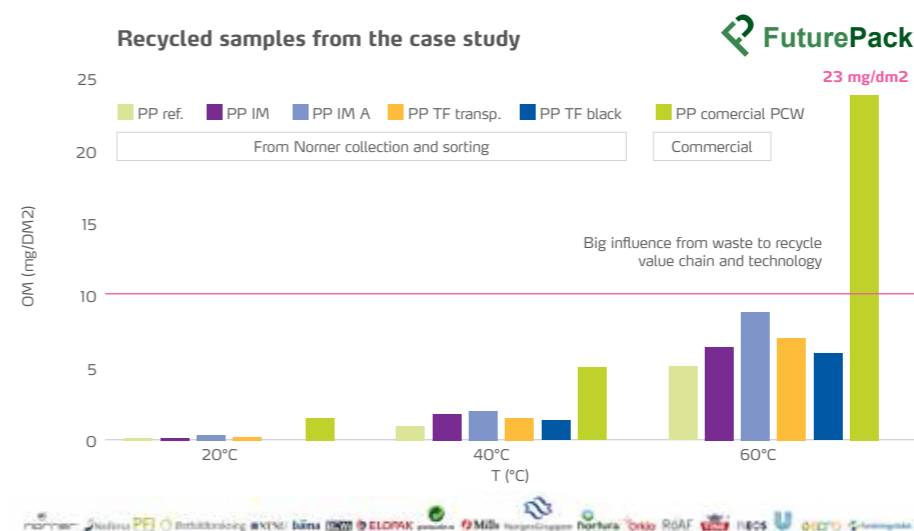
BOOSTING PROCESSING STABILITY OF RECYCLED PP BY AVOIDING DEGRADATION IN MULTIPLE EXTRUSIONS

Polymers suffer inevitably from degradation during processing and use. Degradation is caused by a range of external factors among which mechanical stresses and thermo-oxidative degradation are key factors. Virgin polymers are additivated to counteract such degradation. In FuturePack, Norner experts have demonstrated how multiple extrusion under industrial conditions used by converters causes consumption of antioxidants and that mechanical properties are dramatically reduced when these antioxidants are consumed. The design and testing of suitable additivation packages to replenish additives in recycled materials is ongoing. This is a requirement

to secure process stability and the desired product lifetime of recycled post-consumer waste. This may even include entirely novel additivation concepts.

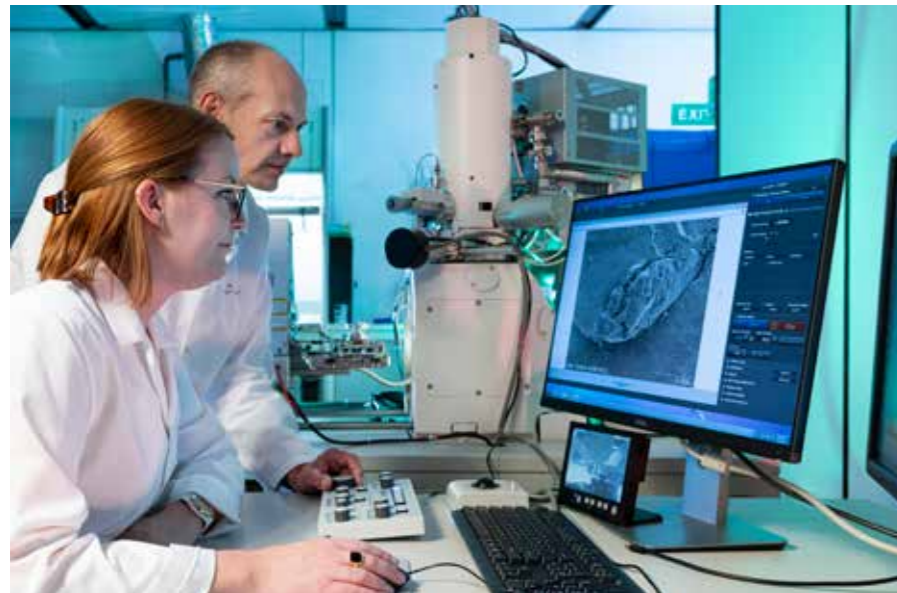
MIGRATION, IAS AND NIAS TESTING AND CHALLENGES IN RECYCLED PP

How suited are recycled plastics for new food packaging? This must be carefully analysed and assessed. NIAS (Non-intentionally added substances) are present in recycled plastics and FCM (food contact materials) are subject to EU and global regulations. NIAS may have a range of different origins – from additives, inks, adhesives, colours, labels, low molecular weight oligomers etc. We have analysed the migration from various recycled materials as well as our own collected waste fractions. We have also made identification and quantification of NIAS. Extraction was done under "worst case" conditions, in 95% ethanol. The results demonstrated that at room temperature, the overall migration (OM) was far less than 1 mg/dm², compared to the OML (Overall Migration Limit) of 10 mg/dm². Even for extraction at 60 °C, the OML was not exceeded for any of the collected and sorted Norner PP samples. The main NIAS components have been identified using advanced GC-MS (gas chromatography with mass spectrometry).



NEW SEM-EDS - Scanning Electron Microscope

Energy Dispersive Spectrometer is installed and in operation:



The SEM (scanning-electron-microscope) is a special useful instrument when it comes to investigate and provide documentation of materials and products.

With our new equipment we can offer a broad and high-quality service within this field.

We have the insight to make microscopy investigation to provide documentation of materials and products. Element mapping and visualization, surface finish, contaminations, failure and fracture investigation in all kind of solid materials

- Consultations and problem solving
- Product and material imperfections
- Weakness in product design
- Material and surface structures
- Flow patterns build in stresses in plastic parts
- Crystal structures
- Powder morphology
- Element analysis
- Phase distribution of inhomogeneous materials

Together with our knowledge and experience Norner can offer a full-range analysis of organic and in-organic materials. We support all levels within research and development, operation and failure analysis.



Better healthcare solutions for all

Norway Health Tech is a non-for-profit member organisation, representing the full value chain of healthcare. Norway Health Tech's mission is to improve quality in treatment and care by developing and industrializing world class health solutions through our members and eco-system.

Norner is a member of Norway Health Tech and we contribute with:

- Comprehensive verification and testing laboratory for medical devices and medical, consumer and food packaging systems according to specifications and/or regulatory standards for product properties, life time verification, high purity solutions and functionality
- Development of sustainable material solutions based on virgin, bio based and recycled materials
- Prototyping and selection of production process in own plastics processing centre or at selected partners in Norner network
- Packaging development and material selection in our R&D material and processing laboratory
- More than 40 years of industrial experience, working globally with clients in the whole plastic value chain.



Norner strategic advisory add value to clients

Our strategic advisory team helps customers to navigate the road ahead by successful strategic choices.



THE KEY SERVICES NORNER DELIVERS WITHIN STRATEGIC ADVISORY ARE:

Business & Market Strategy

- Strategic studies
- Market & Product
- Raw materials & feedstock
- Technology strategy
- Product harmonisation

Creating Added Value

- Value added product strategy
- Asset capabilities

Cost reduction programs

- Strategic raw material optimisation & sourcing
- Make/Buy strategies

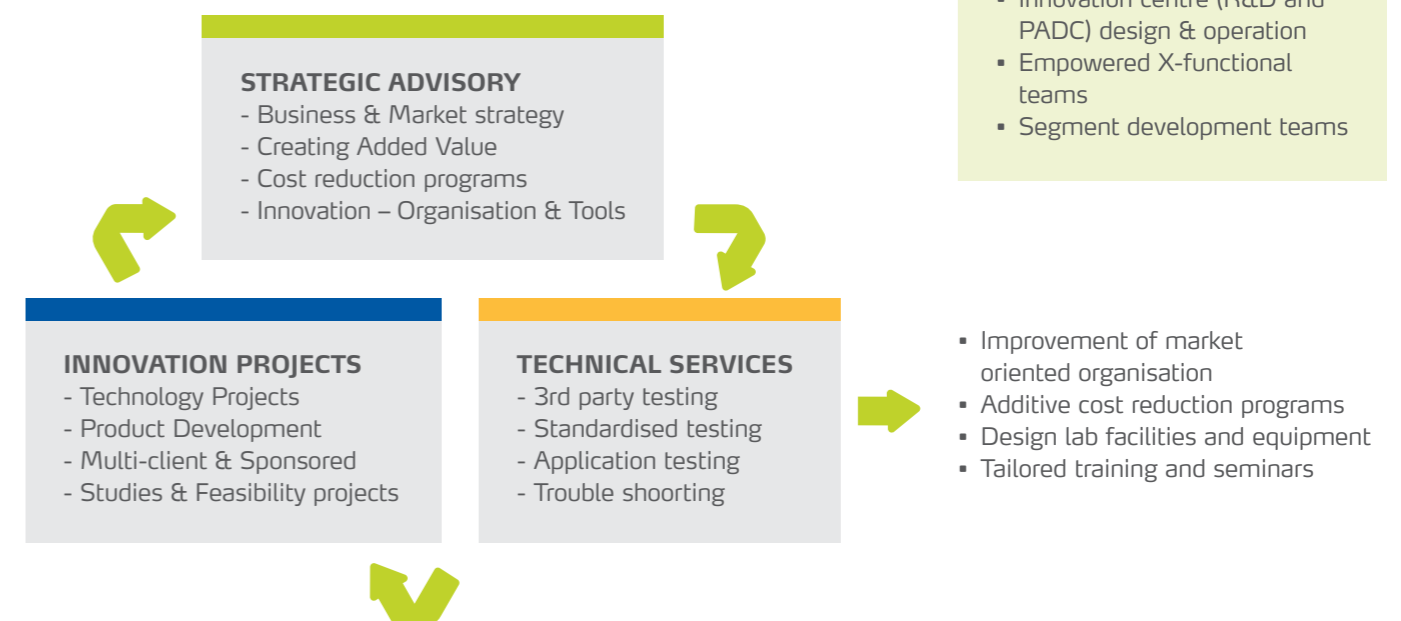
Innovation

– Organisation & tools

- R&D portfolio strategy
- Innovation centre (R&D and PADC) design & operation
- Empowered X-functional teams
- Segment development teams

STRATEGIC ADVISORY GUIDE

- Strategic Advisory combines the experience from different aspects of Norner's operations and support clients with successful strategic choices.
- Norner market- and application understanding and value chain approach are essential elements in developing strategies for product development and launch.
- Product development projects are carried out according to systems and processes refined during Norner's long history and supported by state of the art processing- and testing facilities.
- We helps clients to be successful in strategic choices, to create added value, to achieve a superior cost position and to set up innovation organization and tools.
- In these areas Norner has experience and methodology that, when facing complex issues, identifies elegant and profitable solutions which serves as a foundation for sound business decisions.



PolyLab

Norner expertise - Increasing customer satisfaction and profit.

"Partnering with Norner will take our polymer production to the next level and will help us launch advanced grades in line with the highest environmental standards".

These words were pronounced by Management Board Member, Executive Director at SIBUR Sergey Komysan at the opening of SIBUR's PolyLab in Skolkovo, Moscow on May 29th 2019.



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During the grand opening ceremony, where also Dmitry Medvedev, Prime Minister of the Russian Federation took part, SIBUR and Norner signed a Memorandum of Cooperation to continue the long-lasting relationship and support the full utilization of the opportunities the PolyLab will offer. During the opening ceremony, BASF, 3M, Reifenhäuser Group and Norner also discussed the importance of R&D for the plastics industry in a panel debate mediated by Mr Komysan.

In Norner News #7 we published an article on the feasibility study for a SIBUR PADC - Product Application Development Centre delivered by Norner. This project provided a comprehensive basis for SIBUR management to decide whether to invest in such PADC or not. The decision was positive and SIBUR named their PADC PolyLab. SIBUR will close to triple its polyolefin capacity when all PE and PP plants in ZapSibNeftekhim are on stream and realized that having own capabilities within Product Development & Launch, Trouble Shooting and Technical Service would be essential to their success.



» Javad Nadimi, Norner (in the middle) discussing application testing of PE film products with Olga Sorokina and Anton Makarov, PolyLab.

In parallel with SIBUR's implementation project where the PolyLab design was finalized, equipment and machinery were procured and the building was constructed, SIBUR and Norner carried out a PolyLab Training project which was designed to cover two main areas;

- Establishing adequate and efficient organisation of the PolyLab, and secure the overall processes within and between the various organisational units in SIBUR
- Train the employees in the PolyLab to secure fast return on investment

From earlier projects with Norner, SIBUR had already established cross functional teams within raw material sourcing (e.g. Additive Buying Team) and within product development (Strategic Market Segment Development Groups) and these teams were utilizing expertise from NIOST - SIBUR's R&D Centre in Tomsk. PolyLab opened new opportunities by closing the gap between product development and market requirement. Hence the various processes within raw material evaluation and approval, product development, plant trouble

shooting and technical support to clients had to be re-designed. Also, the PolyLab organisation had to be developed to handle the PolyLab workflows efficiently and to enable a smooth cooperation with the other organisational units and cross functional teams.

Norner and SIBUR collaborated closely to develop the best processes and with the participation of Norner, SIBUR organised workshops to inform and motivate internal stakeholders.

SIBUR had recruited top-notch experts from own ranks and from value chain companies downstream of polymer production who absorbed the experience and know-how transfer from Norner. A comprehensive training program covering all aspects in the polyolefin value chain was established.

The training was spread over two years and 4 stages;

- Theoretical class room training at Norner in Norway
- Practical training in application testing and processing on Norner's equipment in Norway
- Practical training in application testing and processing on PolyLab's equipment in Russia
- On-call follow-up

A good overview and understanding of the whole value chain is necessary to develop value added products meeting the requirements from demanding clients, hence the theoretical training covered not only application testing and processing but also areas like catalysts, additives, polyolefin production techno-

"We highly appreciate our relationship with Norner and recommend them as strong and respectable partner for cooperation in the polymer production business."

» Right to left, Sergey Tutov, R&D Director SIBUR giving Mr Medvedev and Dmitry Konov, CEO of SIBUR a tour in the PolyLab.



logies and characteristics of other polymers than polyolefins.

During some weeks of practical training, PolyLab application experts produced articles using conversion equipment in Norner's Application Centre and their expert laboratory colleagues tested the articles using application testing equipment in Norner labs, all under mentoring of Norner experts. Some of the work was also carried out as model innovation projects to make the experience as realistic as possible.

Once SIBUR had installed own equipment, parts of the practical training were repeated in the PolyLab. Norner experts stayed in Moscow for some weeks to secure that methods would work on the new equipment as this was in part different from equipment in Norner's Application Centre.

To back up SIBUR in reaching excellence and full utilization of what the PolyLab can offer, also an on-call support arrangement was agreed. PolyLab experts have access to weekly video meetings with their counterparts in Norner to solve issues and discuss relevant challenges.

Norner has received very positive feedback on the effect of the PolyLab Training project and are proudly referring to quotes from an official reference letter from SIBUR;

"The collaboration shows deep expertise of Norner in polymers (exceptionally in Polyolefins), excellent understanding of R&D methodology and modern approaches in organizing R&D processes in the petrochemical industry."

SIBUR 2018 - THE LARGEST POLYMER MANUFACTURER IN CIS

- Produce PP, PE, BOPP, PET, EPS, rubbers ...
- > 26 000 employees
- Turnover of 9,1 bn USD
- EBITDA 3,3 bn USD

NORNER STRATEGIC ADVISORY COVER

- Business & Market Strategy
- Creating Added Value
- Cost reduction programs
- Innovation, Organisation & Tools



» Sveinung Aasetre, Norner sharing his >30 years' experience in Injection Moulding.

Sustainability

is a choice and a business opportunity

The Sustainability Development Goals have the potential to unleash innovation, economic growth, and development at an unprecedented scale and could be worth at least \$12 trillion a year in market opportunities and generate up to 380 million new jobs by 2030.

While business is not being asked to deliver the SDGs alone, the goals cannot be realized without engagement by individual companies. Norner believe we can contribute as a driver of innovation and technological development, which together with our clients will serve as key engine of economic growth, employment and development of a circular economy.

Companies that align their operations with the SDGs and are able to communicate clearly about how their business helps to achieve the SDGs are likely to be able to consolidate a strong license to operate and to differentiate themselves from competitors.

We believe the SDGs represents significant innovation challenges and a massive market incentive for companies who are able to offer SDG-relevant technologies and solutions through sustainable and inclusive business models.

As an innovation partner Norner will strategically focus on four of the SDGs where we have the highest impact:

9 Proactively support innovation in the plastics value chains on a global basis and inspire through competence and methodology.

12 Engage in projects for better resource efficiency and limit waste generation through prevention, reduction, recycling and reuse.

13 Drive projects where our solutions can enable improved sustainability, reduced energy consumption, GHG emissions and introduce renewable materials.

14 Be in the forefront of technology for circular economy, recycling and renewable solutions and take own action against marine littering.

We look forward to drive forward new business solutions together with our clients and strengthen their competitiveness and resilience whilst contributing to the realization of the SDGs.

9 INDUSTRY, INNOVATION AND INFRASTRUCTURE



12 RESPONSIBLE CONSUMPTION AND PRODUCTION



13 CLIMATE ACTION



14 LIFE BELOW WATER



NORNERNEWS

