

SOLVING POLYMER CHALLENGES

- ✓ Consultancy & research
- ✓ Pilot plant & specialty products
- ✓ Analysis & equipment
- ✓ Cooperation & spin-offs

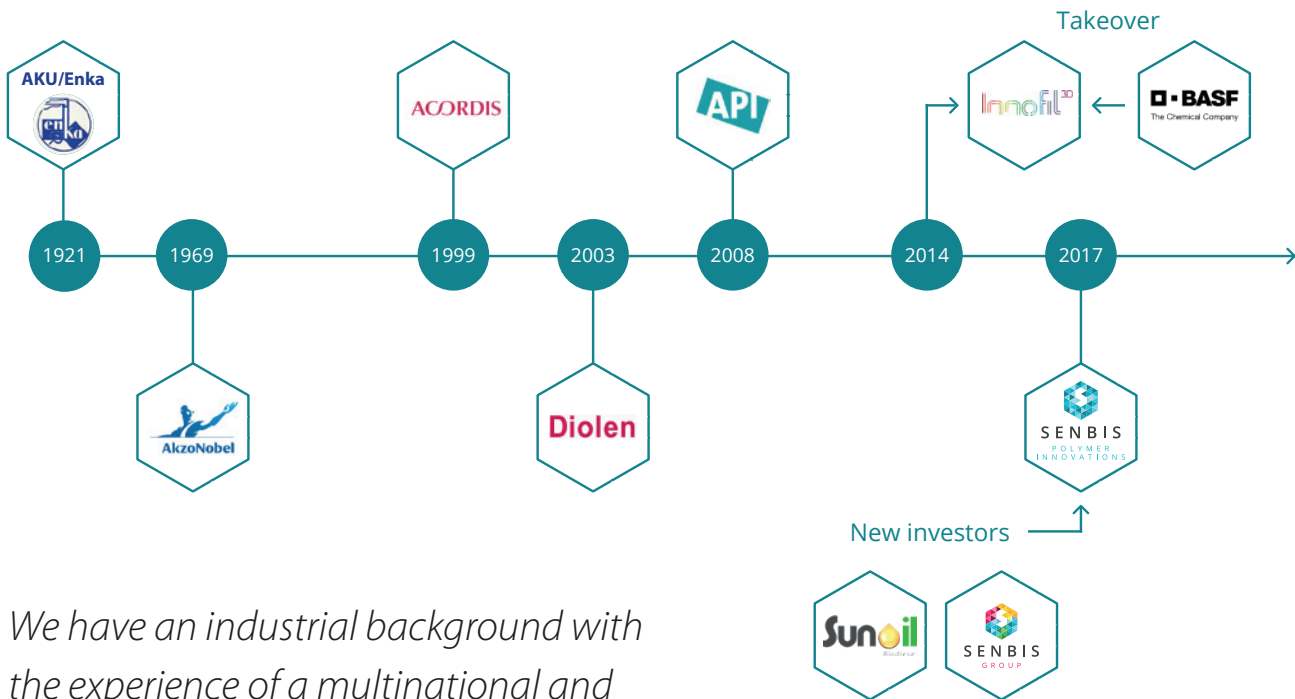


SENBIS
POLYMER INNOVATIONS

WWW.SENBIS.COM

ABOUT US

Senbis Polymer Innovations is a privately owned company that supports its customers with applied polymer research. Our organization has over 25 years of experience in polymer research with a specialization in the development of high-end applications of (bio)polymers.



We have an industrial background with the experience of a multinational and the culture of a start-up!

CONSULTANCY & RESEARCH

We offer R&D services throughout the plastic industry and have a special focus on yarns and filaments.

Our services include:

► **Designing and optimizing production processes**

Such as: filament extrusion, spinning and drawing and polymerization

► **Developing new polymer applications**

Such as: biopolymers in existing and new applications

► **Developing yarn or monofilament from biopolymers or recycled plastics**

► **Solving quality issues**

Such as: pollutions in resins, broken filaments, spin finish issues, inconsistent shapes or diameter

► **Making compounds Fit-for-Purpose**

Such as: for applications in 3D printing, melt spinning (multifilament yarn)

PILOT PLANT & SPECIALTY PRODUCTS

In our pilot plant we have unique facilities to produce specialty compounds, yarns and monofilament products. Additionally, we offer our capacities to customers for research or proof-of-concept purposes.

Extrusion-compounding

- ▶ Several extrusion machines, from 1 kg/hr to 10 kg/hr
- ▶ Twin screw extruder available (ideal for compounding both pellets and powder)
- ▶ Different processing techniques available: Monofilaments (e.g. for 3D printing), film casting, film blowing, kneader, rheological measurements and more

Spinning-drawing

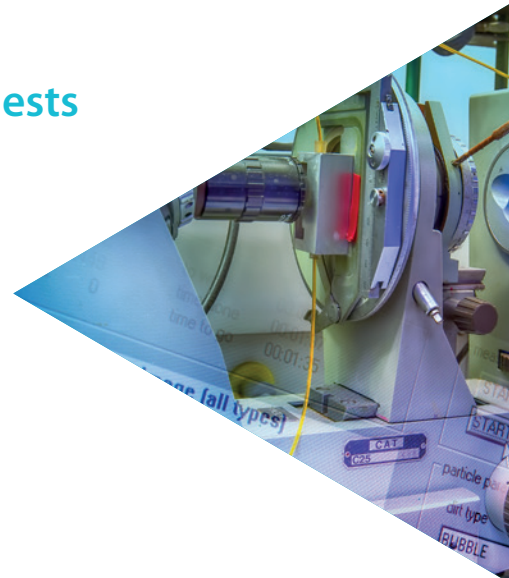
- ▶ Small scale research machine extrusion: up to 400 °C, 2.5 kg/h, up to 500 m/min
- ▶ Technical yarn spindraw-winding (SDW) extrusion up to 350 °C, 70 kg/hr, 5000 m/min, drawing 250 °C
- ▶ Tire yarn spin-draw-winding (HSSDW Extrusion 350 °C, 80 kg/hr, 8000m/min, drawing 240 °C
- ▶ Several drawing lines available with hot pins, plates and ovens

Drying – SSP – polymerization

- ▶ Drying masterbatches up to 60 kg
- ▶ Solid State Polymerization (SSP) from a few grams to a few kg up to 120 kg per batch
- ▶ Polymerization of polyester and 'polyesters like' materials up to 0.5 kg. We have access to a 20 kg facility

We produce specialty products on customer requests

- ▶ Specialty masterbatches/compounds
- ▶ Monofilaments and yarns for high end applications
- ▶ We can process high performance plastics such as PEEK or PEI
- ▶ Monofilaments and yarns made from biopolymers or recycled plastics



ANALYSES & EQUIPMENT

Rheologic measurements

- ▶ Extrusion rheometer (realistic conditions)
- ▶ Apparent shear viscosity vs. apparent shear rate
- ▶ Master curves for rheological calculations
- ▶ (Rheotens) melt strength curve
- ▶ Elongational rheometer
- ▶ Plate-plate rheometer
- ▶ Melt Flow Rate (MFR)

Yarn quality control

- ▶ Tensile properties determination
- ▶ Off-line measurement of finish distribution on (running) yarn
- ▶ Finish content on yarns
- ▶ Evaporation rate of finish (components)
- ▶ Friction (yarn-to-metal and yarn-to-yarn) properties
- ▶ Mechanical periodicity measurement on Tensorapid 3
- ▶ Flory test equipment for mooring ropes applications

Yarn analyses

- ▶ Linear density
- ▶ Tensile tester
- ▶ Hot air shrinkage
- ▶ Rothschild entanglement tester
- ▶ (Ir)regularity testing
- ▶ Shrinkage force

Physical structure analyses

- ▶ Sonic modulus
- ▶ Density (Davenport column)
- ▶ X-ray diffraction
- ▶ FTIR spectroscopy
- ▶ Solution viscosity
- ▶ Microscopic imaging (e.g. visible and polarised light-, interference-, and fluorescence techniques)

Thermal analyses

- ▶ (Hyper) Differential Scanning Calorimetry (DSC)
- ▶ Thermo Gravimetric Analysis (TGA)
- ▶ Thermo Mechanical Analysis (TMA)
- ▶ Dynamic Vapour Sorption (DVS)
- ▶ Dynamic Mechanical Analysis (DMA)
- ▶ Thermo Stress Analysis (TSA)

Quality control of resins and granulates

- ▶ Measurement of impurities by using Particles In Solution
- ▶ Standard Filtration Test (SFT), including SEM analysis of the resulting filter
- ▶ Measurement of water repellency
- ▶ Image processing of both microscopic and macroscopic images

For more information call +31 591 69 2117 or visit www.senbis.com

COOPERATION & SPIN-OFFS

Cooperations

At Senbis we have close relationships with our customers. We are open for a variety of cooperations.

Please approach us if you see potential. Examples of cooperations are:

- ▶ **Mutual development** of products e.g. in shared ownership
- ▶ Production of dedicated **specialty products** for you
- ▶ **Support of educational institutions** with valorization and with the experimental part of their education programmes
As an example we have a good cooperation with the NHL Stenden University of Applied Sciences
- ▶ Being your dedicated **R&D partner**. Having a fixed partner can save you costs while still having support by professionals that know your organization and challenges
- ▶ **Co-investments** into new laboratory and pilot plant infrastructure (see www.spic-emmen.nl)

Spin-off development

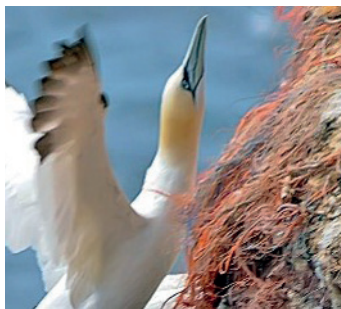
For our spin-off development we have launched the brand Senbis Sustainable Products.

All our own successfully developed products will be produced and sold by Senbis Sustainable Products.



Examples of our developed products

Biodegradable fishing net protection



Biodegradable trimmerline



Compostable horticulture twine



PLEASE DON'T HESITATE TO CONTACT US!



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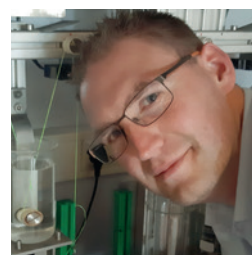
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