

# EXTRUSION SOLUTIONS



Chooses



Leading Bioresin  
Producer Uses  
ENTEK Extruders  
for Wide Variety  
of Eco-Friendly  
Applications



The bioresin revolution is in full swing, and industry forecasts show the demand for these types of materials increasing dramatically over the next few years. BCC Research estimates that the global market for biodegradable plastics will reach 1.2 billion pounds by 2012, more than double its estimated level of 541 million pounds in 2007.\*

ENTEK Extruders are widely used in the bioresins field to not only successfully compound materials, but to help companies reduce their time to market with new products. One of those companies is DaniMer Scientific LLC, a Bainbridge, Georgia based company that manufactures biopolymers that are being used to produce a wide variety of environmentally friendly products.

## First Twin-Screw Extruder

ENTEK's relationship with DaniMer began with a phone call in 2007. "I received a call from DaniMer, who had seen our ad promoting our work with bioresins and asking about our twin-screw extruders," said John Effmann, ENTEK Director of Sales and Marketing. "After a series of meetings they purchased their first twin-screw extruder, an ENTEK 40mm for development work."

Business is good at DaniMer – today, the 40mm extruder originally purchased for development work is now used for ongoing development projects and for running production lots of materials that are being validated by converters for new product launches. DaniMer recently purchased two larger ENTEK twin-screw extrusion lines that are operating around the clock in a new state-of-the-art facility in Bainbridge.

## Reducing Dependence on Petroleum

With a mission to "reduce dependence on petroleum and enable people and communities to benefit from environmentally-friendly products", DaniMer specializes in developing custom bioresin formulations for a variety of applications in injection molding, extrusion coating, extrusion lamination, thermoforming, films and additives. Many of the company's products are based on Ingeo biopolymer from NatureWorks®. DaniMer also produces a number of proprietary bioresins that are based on unique technology developed by their team of scientists and technicians. One of DaniMer's recent product line additions is a family of biodegradable adhesives based on renewable materials rather than petroleum based materials.

One of the company's success stories was its development of the world's first commercially successful extrusion coating resin that utilized PLA as the primary material for coating paper, paperboard and fabric. This FDA-approved bioresin is suitable for hot and cold serve applications and is BPI certified to ASTM standards as compostable. It was adopted for use by Green Mountain Coffee Roasters and International Paper when the companies unveiled their all natural, disposable hot beverage cup. Today this product is used by several large brand owners to produce a broad array of renewable, compostable containers that enable a greater sustainability profile in their product lines.

"DaniMer's mission is to enable our partners to create value for their businesses and customers through the use of renewable-based, compostable and biodegradable resins", said Daniel Carraway, DaniMer's CEO.

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## On the Rebound

“Our lean journey began over four years ago – and it will never end.”



As most of you know and experienced first-hand, we have just endured one of the worst economic periods of our lifetimes. 2009 was a year that most of us would like to forget, business-wise. However, I'm happy to report that things are looking up for ENTEK, our customers, and the economy as a whole. I'd like to share a few thoughts with you on the recent turbulent times, and what we have learned.

### Keeping it Lean

An important lesson we have learned from these difficult times is that lean manufacturing principles are essential. At ENTEK, our lean journey began over four years ago – and it will never end. We have worked hard to eliminate waste and improve productivity at every level of our business. It has been a culture change that greatly helped us get through the tough times.

We've learned that effective lean practice requires the full support of our workforce. That starts with trust and respect throughout the organization. This has to be earned initially and maintained constantly. During the tough months of 2009, we shared the pain of a terrible economy by cutting hours for everyone in the company, from the President to the most recent hire. We shared the pain, but sought to maintain a family-supporting wage for our people. One measure of ENTEK's success in this effort is that our employees voted ENTEK as the 12th best company to work for in Oregon in 2009 (see article on p. 6). We emerged from the Great Recession a better company than we went in. We're proud of that.

Lean operations at ENTEK have also helped our customers. All lean efforts have led to a significant decrease in lead times for our products – for example, if a customer needs a screw element and the part is not in stock, we are able to deliver within 3 weeks.

We have shared our philosophies with customers so they fully understand what the implementation of lean means to us, and to them. There are numerous ways lean principles at ENTEK have helped customers improve their operations and save money. This has truly been a win-win situation.

### Back on Track

As I write this, we are entering the 4th quarter of 2010 and we at ENTEK are seeing much better business activity. Sales of our twin-screw extruders are strong, and our lab is seemingly constantly busy running trials of biopolymers, wood-plastic composites and other compounds.

Thank you to all of our customers for working with us to get through the hard times. As always, we appreciate your business and look forward to working closely with all of you to help improve your processing operations.

I hope you enjoy reading our latest newsletter and as always, I encourage you to contact me anytime at [khanawalt@entek-mfg.com](mailto:khanawalt@entek-mfg.com).

Sincerely,



Dr. Kirk Hanawalt  
Vice President/Chief Operating Officer, ENTEK Manufacturing, Inc.

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## Processing Support

DaniMer has received support from the beginning from Bill Petrozelli, ENTEK’s Technical Sales Manager. Bill is an expert on twin-screw extrusion and helps customers with training, processing expertise and overall service. “ENTEK’S technical support staff has been a key factor in our decision to invest in a long-term relationship with ENTEK. The world-class customer support we get from our partners at ENTEK is an important part of our ability to keep development and production projects on track”, said Carraway.

## The Future is Green

As mentioned in the last issue of *Extrusion Solutions*, bioresins are clearly a very real, fast-growing trend in the plastics industry. ENTEK has seen a sharp increase in bioresin lab trials over the past few years. “A handful of companies including DaniMer Scientific saw this trend coming, and as developers of some of the first commercially successful bioresins and products, they are the innovators in this field,” said John Effmann. “We are proud to be their machinery provider and look forward to a long-standing relationship with them.”

\* – from the report “Biodegradable Polymers”, December 2007; BCC Research, Wellesley, MA USA, [www.bccresearch.com](http://www.bccresearch.com).

## ENTEK Metallurgy – Ensuring the Best Wear Resistance for Your Barrels and Screws

One of the most important factors in the success of any twin-screw extruder application is the materials of construction used on the screws, barrels and other wear parts. The success or failure of the twin-screw extruder, especially when processing highly abrasive or corrosive materials, depends on the ability of the parts to perform well under difficult processing conditions. This article provides an overview of what we at ENTEK have learned over the years about manufacturing screws and barrels.

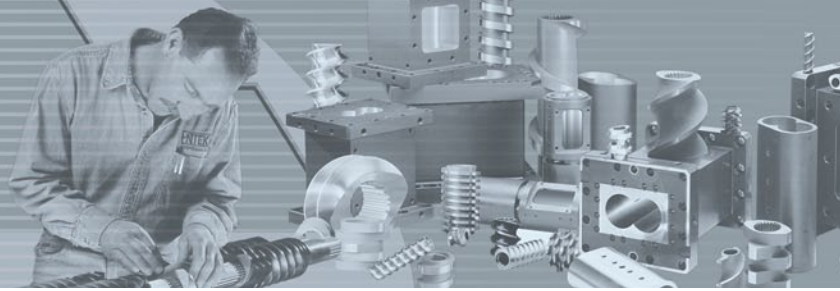
## A Brief History of ENTEK Materials of Construction

ENTEK’s screw and barrel business has changed from 70% nitrided tool steels, 20% through-hardened tool steels, and 10% Hot Isostatic Pressed (HIP) alloys 12 years ago to a very different product mix today: 10% nitride, 30% through-hardened, and 60% HIP. 9V screws / 10V barrels were the most common HIP metallurgy choice 10 years ago. Now, HIP alloys with better wear resistance and higher corrosion resistance are more frequently requested by Customers.

ENTEK started by purchasing HIP materials from vendors – this made sense when volumes were relatively low. As volumes for HIP parts grew as a result of ENTEK’s growth and our Customer’s move from nitrided tool steels to the higher performance HIP materials, transportation time and cost spurred ENTEK to develop in-house processes for manufacturing HIP blanks ready for final machining.

Doing this allowed us to lower costs for our Customers, shorten the supply chain, reduce lead-times, and manage inventory levels to better match Customer demand.

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## Corrosion Resistance

Corrosive applications make total wear resistance more complicated. Corrosive wear is indicated by pitted surfaces and the rounding-off of sharp corners. High-chromium tool steels are typically the best and most cost-effective defense against corrosive wear. Note that traditional Stainless Steels, for example 304SS, are almost never used for extrusion. Although 304SS is difficult to machine, it offers very low abrasive wear resistance and does not offer good value for either an extruder barrel or screw.

More exotic materials may be required where extreme corrosion is present, for example when processing fluoropolymers and their monomers. Inconel and Hastelloy are often used for these applications. These alloys offer superior corrosion protection through high nickel and chromium content. However, these exotic alloys have Rockwell C hardness values of 35 or less, so they don't offer good wear resistance. They are also expensive; the raw materials are very costly and are difficult to machine. For these reasons, the high nickel alloys are not widely used in extrusion except where corrosion is so severe as to justify the expense and reduced wear resistance.

## Barrels and Screws

Ten years ago, ENTEK made barrels in one piece for a single-use and then discard. Today, barrels are made almost exclusively with replaceable liners. This is a bit more expensive up front because of the extra machined surface where the liner and the holder meet, but the long-term cost of ownership is significantly reduced. A lined barrel can be refurbished by removing the worn liner and inserting a new one. The body and flanges of the barrel - which contain the cooling passages, thermocouple wells, injection ports, and counter-bored holes for bolting barrels together - can be re-used indefinitely. There is considerable expense in machining all of

these features, which is why the higher upfront cost of the lined barrel can be recovered quickly compared to installing a completely new barrel every time.

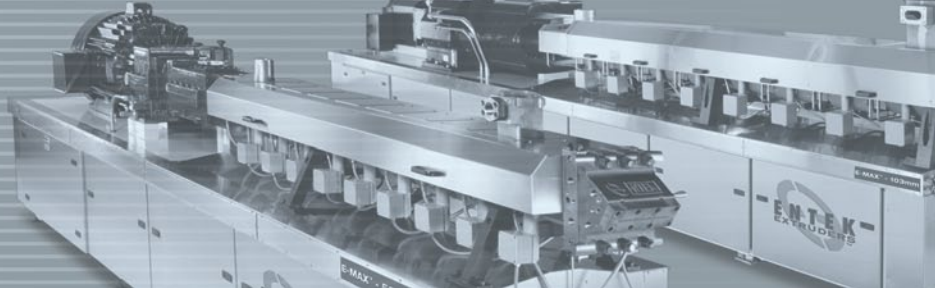
ENTEK makes most of its screw elements in a bi-metallic construction. The core where the screw spline resists torque overloads better than the high-wear but more brittle HIP material on the outside of the element. Ordinary solid HIP screws are very prone to breakage when torque exceeds normal limits, for example when an extruder is over-fed with material and the screws stall.

Typical practice in extrusion is to make the screw out of material that is equal or slightly less wear resistant than the barrel material. Screw geometries are more complicated than barrels and the tolerances are similar, but because of the large amount of material removal required to make a barrel it is less expensive to replace screws than barrels.

## Conclusion

Years of experience have helped us learn what works best for materials of construction for screw and barrel wear resistance. We use this knowledge to manufacture the best quality wear parts we can for our customers. However it is important to note that every application is unique. Testing of any materials compound by processing it in a controlled lab environment is essential to compile the data necessary to determine the best materials of construction. The ENTEK in-house development lab is ideal for this type of activity.





## Processing Tips for Twin-Screw Biopolymer Extrusion

The ENTEK in-house lab has been busier than ever, and a lot of the activity is with biopolymers. With numerous lab trials performed on a variety of bio materials, we have compiled a list of best practices for processing these materials on twin-screw extruders.

Dean Elliott, ENTEK's Lab Manager, recently gathered up this data and wrote a white paper entitled 'A Guide to Successful Twin-Screw Extrusion of Biopolymers' that was published in *Compounding World* magazine. This paper provides descriptions of the various types of biopolymers and guidelines to the successful processing of each type.

The paper is posted on ENTEK's web site and can be viewed on the 'Bioresins' page at [www.entekextruders.com](http://www.entekextruders.com) – or contact Tammy Heider at ENTEK at [theider@entekplus.com](mailto:theider@entekplus.com) if you would like to receive a printed version of the paper.



## ENTEK Establishes Relationship With Magog UK For Extruder Screw And Barrel Sales

To better serve its customer base in the United Kingdom, ENTEK is pleased to announce it has entered into a relationship with Magog, a leading UK-based manufacturer and refurbisher of screws and barrels for the plastics industry.

Magog will sell and service ENTEK replacement wear parts for both ENTEK and non-ENTEK brand twin-screw extruders throughout the UK. This includes the recently introduced ENTEK wear-resistant conical barrels for PVC extrusion.

Based in Ware, Hertfordshire, Magog has been in business since 1964. The company is a leader in the manufacturer and refurbishment of extruder, injection molding and compounding screws and barrels.

"We are delighted to have Magog representing ENTEK in the UK," said John Effmann, ENTEK Director of Sales & Marketing. "There has been an increased demand for our replacement wear parts there and Martyn Denzel (Sales Manager), Roger Spendley and the Magog team are well qualified to provide our customers with excellent sales and service."

More information on Magog Industries can be found at [www.magog.co.uk](http://www.magog.co.uk).

**MAGOG** Industries Limited



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ENTEK  
Manufacturing  
Named To  
"100 Best  
Companies  
To Work For  
In Oregon"  
List By  
Oregon  
Business  
Magazine



ENTEK is proud to announce it has been named to the "100 Best Companies to Work For in Oregon" list by *Oregon Business* magazine.

This list, published annually by *Oregon Business*, recognizes large, medium and small companies for excellence in retention and rewards, work environment, decision-making and trust, performance management, career development and learning. The winners were revealed in the March 2010 issue of *Oregon Business*, available at [www.OregonBusiness.com](http://www.OregonBusiness.com).

Over 300 companies participated in this year's 100 Best survey, which analyzes Oregon companies' best practices in creating great places to work. Almost 20,000 Oregon employees completed the survey, where they rate their satisfaction in 50 workplace qualities.

"We are honored to be included in the 100 Best list," said Larry Keith, ENTEK President. "It is gratifying to know that even in these challenging times, our employees feel that ENTEK is a great place to work. We're proud of our company and our employees, who we know are our greatest asset," he said.

## Upcoming Events



### Biopolymers Summit 2010

October 11-13, 2010,  
The Westin Tabor Center, Denver, CO, USA