

The WBE EZ hog is capable of processing biomass at up to 220 t/hour

A fine grind

This US company has developed some of the foremost biomass processing machines in the world and is ready to take on the expanding European biomass market. Chris Cann reports

More than 60 years of experience in the business of biomass processing has industry stalwart Jeffrey Specialty Equipment perfectly positioned to take advantage of the current surge in demand for biomass machinery.

The biomass industry has grown incredibly in the past two years, fed tirelessly by the need to increase capacity and efficiency with a heightened consideration for the environment from society that is enforced by legislation and financial incentives. Harvesting, sawmilling and pulp and paper companies are turning to

biomass processing as a way of fully utilising the raw material felled.

South Carolina-based Jeffrey, now a subsidiary of K-Tron International, started commercial life well over a century ago as a supplier of coal-cutting machinery and then underground mechanised miners,

crushers, locomotives, cars, rams and power shovels for the mining industry. The obvious synergies with size reduction led to the forestry arm of the business as the company developed machines for wood and biomass reduction in the 1940s.

The forestry arm had been responsible for about 40% of total company sales two years ago, however, with the explosion of the biomass industry that figure has grown by half again, and size reduction equipment for use by pulp and paper, panel board, sawmilling, and wood energy industries now makes up 60% of Jeffrey sales.

The chief Jeffrey machine-line for processing biomass is the wood hog. Those close to the industry would also know these units as hammer mills, shredders, and grinders – or just hogs. The company's sales in the past have been dominated by its series 40 or series 50 ranges, which work at a rate of about 20-50 t/hour of material. But all that has changed quite recently and it is now the bigger models that are the best sellers, a trend that accurately reflects the industry, according to Jeffrey Sales and Marketing Manager, Doug Sublett. He said the biomass processing arm of the business had grown as the environmental issues

associated with climate change had increased. Jeffrey has doubled its sales of 60 series machines for two years running. The 60 series machines typically operate at a 100 t/hour rate.

“Our most dramatic growth has been in the last two years and we see it in two ways. Firstly, the number of machines that we're selling in the wood hog range, and secondly the size of machine we're selling. The number of machines we're selling has more than doubled and the physical size of the machine – the amount of material that can be processed – has probably doubled as well. We're now making machines that can process up to 220 t/hour,” Sublett said. “The market has gone toward these very large machines across the board. And that all has to do with the amount of biomass being processed.”

HOGS FOR PELLETS

A perfect example of the direction in which the biomass industry is headed can be seen in two recent orders filled by Jeffrey. Jeffrey has delivered machines to two massive wood pellet mills that have just been established in the US, one of which is apparently bigger than anything else previously built worldwide. Green Circle Bio Energy (owned by Swedish company JCE



Doug Sublett, Sales and Marketing Manager, Jeffrey

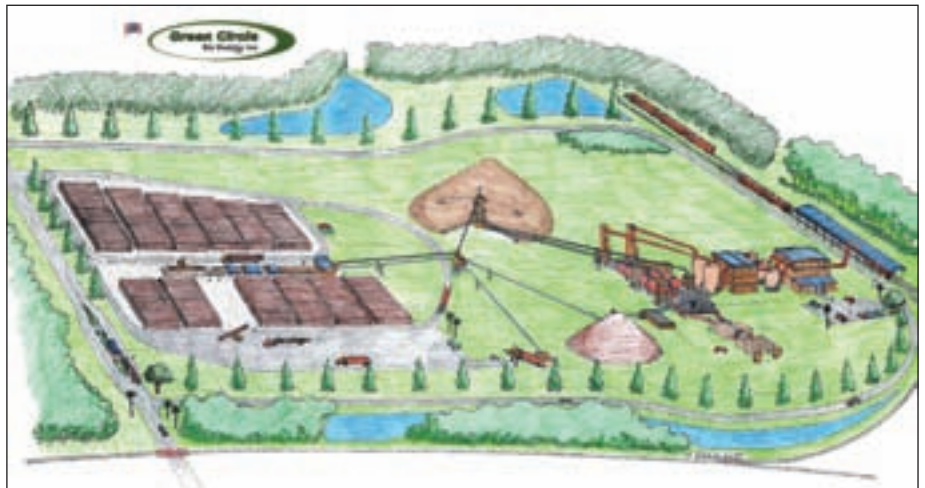
Group AB) has built a pellet plant with a world-record capacity of 560,000 t/y in Florida, while Dixie Pellets (owned by US company New Gas Concepts) had almost completed construction of a 500,000 t/y capacity plant in Alabama. Green Circle is up and running, while Dixie was being finished at time of writing though some smaller lines were already running. Most of the mills' combined capacity of more than 1 Mt/y will be shipped into a European market hungry for pellets to feed anything from residential boilers to large co-fired coal plants.

A large European market has been evolving for some time on the back of regulations aimed at fighting global climate change which have created incentives for power companies to boost their use of renewable resources. Europe already consumes nearly 8 Mt/y of wood pellets to run factories and power plants, and to heat entire neighbourhoods.

Another plant is reportedly being built by DG Pellets – also in Alabama and also owned by New Gas Concepts – that plans to eclipse the Green Circle plant production by generating more than 600,000 t/y of wood pellets.

Though Sublett remained tight-lipped about the details of the Jeffrey deliveries to Green Circle and Dixie, he did say that three 800 horse-power plus machines were sold, capable of processing bark and wood chips at high rates with very tight product specifications. Machines of that size retail at between \$200,000-\$250,000, meaning those two orders alone netted Jeffrey a minimum \$600,000 gross. Given two primary hogs are said to be used at Dixie it could also be assumed they would both be Jeffrey machines.

Those machines are from the company's largest machine range at the frontline of hog



A sketch of the biggest wood pellet plant in the world

technology – the WBE EZ Access wood hogs. The Model WBE wood hogs have been redesigned with Jeffrey's exclusive EZ Access™ technology, which allows safe, fast, and easy access to the hammers, rotor, and liners, according to the company website. "Maintenance operators can safely and quickly clear plugged chutes to minimise downtime and perform routine maintenance with more safety and ease. The new EZ Access technology also lets operators remove the wood hog's rotor without removing the feed chute," the site spruiked. The technology can also be added to existing Jeffrey wood hogs using a retrofit package.

Sublett: "With the front folding down it means you can get in and maintain the machine very quickly. We also use replaceable tip hammers now so as opposed to replacing the whole hammer you just replace the tip. The hammers in these machines are about 150 lb a



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piece so changing them can be a real struggle, but the tip is only 25 lb"

He said maintenance requirements for the WBE EZ range depended almost entirely on the cleanliness of the material being processed. Sublett said 90% of servicing was devoted to the hammers and the grates, and hammer sets were generally replaced three times before the grate needed replacing.

"If the wood is clean you can see eight months on a set of hammers. But if the wood is full of sand, dirt, grit and everything in between then it might be two weeks. The example for the latter would be a mulch manufacturer who is using a front-end loader to pick up all the junk off the ground and half the dirt. As the dirt increases so does the wear on your machine," Sublett said.

Other features of the WBE EZ range were multiple hammer designs available for both standard and SS design rotors; lower housing extended to provide 180° of screen grate area; disc-type rotor assembled on a high, alloy-steel shaft and is mounted in self-aligning spherical roller bearings in rugged steel housings; substantially reduced maintenance time because the rotor shaft is drilled for the hydraulic removal of the bearings to ensure quick bearing removal without damaging the shaft.

In addition the hogs have Slant-Flow® screen grates that are unique to Jeffrey wood hogs and, unlike conventional screen sections, the



The Jeffrey hogs are made to order



Hammer speed is adjusted according to client needs

Slant-Flow design is angled into the flow of the material being shredded. This gives more shredding action and allows the material to evacuate faster.

The liners are manufactured from thick abrasion-resistant steel plate to protect against high impacts and normal wear, and every Jeffrey wood hog has an integral metal trap that effectively collects the odd pieces of smaller tramp metal that can damage the hog. Rolled-steel, structurally reinforced housings ensure long-lasting durability. When properly maintained, the hog's fully lined interior prevents the housing from wearing on the inside.

The way these machines are used differs between the Green Circle and Dixie plants. In Alabama at the Dixie plant, the WBE EZ hogs are used as a primary facility. The material is bought locally from different mills or chippers in wood chip form at a pre-specified size and the hogs grind that material to the appropriate size for efficient drying. Once the material is dried it will go through a secondary process and is then shipped.

The Green Circle plant is set in the middle of an established pine plantation and is importing whole trees to be processed with a knife chipper in the first instance before secondary processing for wood chips. Here, Jeffrey hogs are used to process bark mainly, along with any other disregarded wood and general twigs and sticks.

"We discussed wood hogs but in the end they [Green Circle] went another direction. Based on our experience with our Chip-sizer technology we felt that using a wood hog would have required far less maintenance. When you start looking at knife-based technology versus hogs to process wood chips, from a maintenance standpoint the knife chipper will be much higher maintenance because you're using knives instead of hammers to do the work, not to mention what happens with you encounter tramp metal."

Sublett said Jeffrey was grateful to have been part of both facilities and felt confident that both organisations would be successful given the current biomass environment.

WIDER USES FOR THE HOG

The function the Jeffrey hogs have at Green Circle is closer to the typical function of the machines. About 65% of Jeffrey's biomass business is devoted to the pulp and paper industry, which would position a hog in the woodyard. Logs are delivered to the woodyard to be debarked and the bark is put through the hog to be ground down to a specified size, typically about 2-inch (5 cm) minus to be sent to the boiler. Fallen limbs and broken wood also go through the hog. The Jeffrey hogs also take pre-hogged material from the field at a size of around 8-inch (20 cm) minus and put it through a secondary hogging process to ready it for the boiler.

About 15% of the business is committed to the sawmilling and panel board industries, where the machines pick up pre-milled and post-milled biomass 'waste' product to process into an end product that the mills can either sell on or use themselves. "Most of the work we do with sawmills has to do with processing sawmill residuals, the material left over after the wood has been converted into its final form. This material includes chips, shavings, cants or

butt ends. The panelboard industry is similar to pulp and paper where we handle most of the material at the front end of the process or in the woodyard and primarily the debarking area," Sublett said.

"Sawmills will typically sell it to someone offsite though some will use it themselves for kilns or firing a boiler for energy of some sort – but they're usually the much smaller mills. Most will sell it off to a pulp and paper mill, while some sell to wood pellet manufacturers."

About 20% of the business is miscellaneous activity like the direct wood pellet business, dedicated energy producers using biomass for firing boilers, and special projects involving gasification or cellulosic ethanol production.

MADE TO ORDER

Different clients require different machines depending on three main factors – the size of the desired end product, the rate at which they need to feed the hog, and the size of the material the client wants to feed the hog. Jeffrey has a range of equipment and can tailor different machines to fit the specifications of

Not just hogs

Jeffrey's other forestry machine is the Chip-sizer, which, as the name suggests, re-sizes oversized wood chips for the pulp and paper industry. The Chip-sizer was pioneered in 1996 in response to industry concern over high maintenance costs for typical re-chippers. Jeffrey was the first company in the industry to research and develop a true no-knife re-chipper, according to the website. Several designs were discussed and tested in the lab before determining that the current patented design would be best suited for the industry. The first unit was put into production in February of 1997 and quickly achieved results beyond anyone's expectations.

The Chip-sizer looks like a typical wood hog. But while the operating principle is similar to a wood hog, the Chip-sizer re-chipper incorporates several special features and components. The hammer allows the unit to operate at speeds much slower than hogs and also offers a "soft-touch" to the chips to keep from creating pins and fines. This along with "other patented components" makes the Chip-sizer re-chipper more efficient than other similar industry products.

"In the pulp and paper mills during the chipping process, as chippers wear or become dull you get what the industry calls 'overs' and/or pins and fines. Our Chip-sizer re-sizes the oversize chips while minimising pins and fines, and allows you to put them back into the process. We see a recovery in the neighbourhood of 90-95% using that machine," Sublett explained.

"The more traditional way to do this before we developed this product was to send 'overs' back through a knife re-chipper – again, high maintenance. A knife chipper requires around \$60,000-\$70,000/y to maintain the knives, whereas you might spend \$10,000/y to maintain the Chip-sizer and still get a good 'spec' product. It's also tramp-metal tolerant, so if you get a piece of metal through the machine it will take it, deposit it into the metal trap and keep on going. If a piece of metal goes into the knife re-chipper it destroys the knives."

Jeffrey has up to 140 Chip-sizer units in the field at the moment and most of the major players use the machine as best practice, Sublett said.



The Chip-sizer will be on display at SPCI 2008 conference in Stockholm this May at the Rader booth

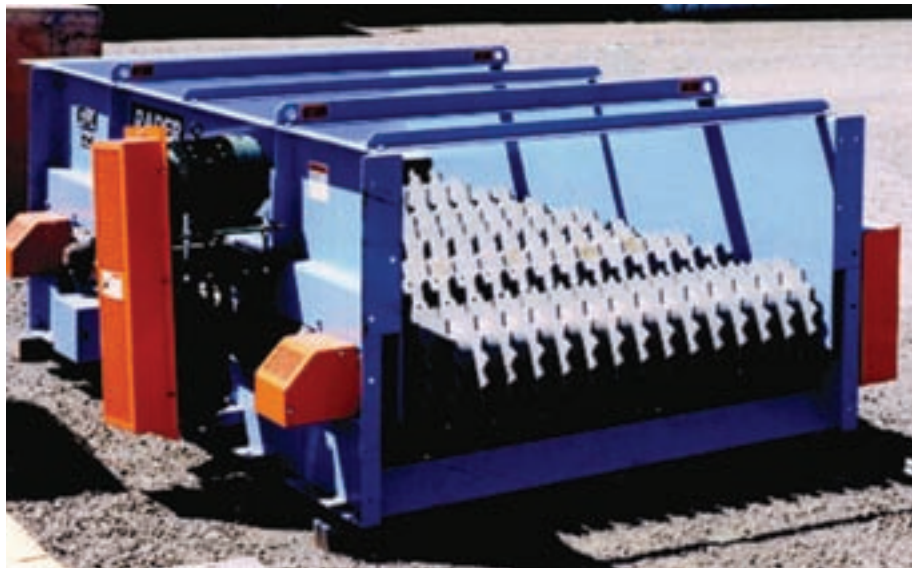


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individual clients. This is done at the company's lab in South Carolina. Once the appropriate model of hog is chosen from the range of 20-220 t/hour machines to fit the feed requirements, Jeffrey selects the proper screen arrangement and selects the proper hammer tip speeds, which can be between 10,000-20,000 feet/minute to produce the appropriate size product according to the order.

Using a sawmill example; a large mill would come to Jeffrey and say it needed to process



The Rader Disc Screen is used to screen material before it enters the hog

biomass material for sale to a pulpmill, which required a 2-inch (5 cm) minus product. The sawmill has a high volume of biomass to be processed so it requires a machine capable of

processing 150 t/hour, and, it will also need to take offcuts and cants. The specification is reviewed and/or tested in the lab and the desired machine is selected to fit the order.

BIOMASS IN BRIEF

UPM-Kymmene to build a renewable energy power plant at its Caledonian mill in Scotland

UPM-Kymmene is building a new power plant to be mainly fuelled by biomass at its Caledonian mill in Irvine, Scotland. The new boiler will utilise a 350,000 t combination of biomass and site derived residues as its primary fuel. The total investment cost is £59 million (\$115 million).

The new power plant, once started-up in the first quarter of 2009, will continue to reduce UPM's carbon emissions by 75,000 t/y. The company has reduced its production related fossil CO₂ emissions by 25 % during the last 10 years by investing in biofuel-based energy generation and in energy efficiency. The latest investments have been in a new boiler plant at the Shotton mill in the UK and power plants at the Rauma mill in Finland and Chapelle Darblay mill in France.

The Caledonian mill power plant will also significantly assist the Scottish Executive in achieving its 2010 national renewables generation target of 18%. The investment further reinforces UPM's Caledonian mill site as being one of the largest ever inward investments in Scotland.



Plantation waste turned to renewable energy

The Forest Products Commission (FPC) in Australia has signed a A\$10.5million contract to supply plantation residues to private company Western Australia Biomass.

FPC General Manager Dr Paul Biggs said obtaining a significant buyer for this material was an important step towards increased profitability for the entire plantation forest industry. "This new agreement offers a local and environmentally sustainable solution for the use of plantation pine residues, which are presently a low value resource."

"This is an excellent example of the FPC partnering with industry to produce a win-win for the environment and the economy," he said. "After five years of joint development work between the FPC and WA Biomass, about 150,000 t/y of pine residue will be converted into renewable energy."

"The FPC is continually working with industry to minimise waste and find maximum value uses for our timbers. This new contract will help make handling of forest residue more efficient and also return direct value to the State of WA."

WA Biomass Executive Adrian Rizza said the company had applied for permission to construct a 40 MW renewable energy power facility near Bridgetown. "WA Biomass has been developing this project for the past five years and the power facility is expected to bring capital investment of around A\$120million to the South West."

"During the construction phase, which is projected to last between 18 months and two years, this new facility is expected to employ up to 300 people. We estimate another 120 new jobs will be created directly and indirectly over the life of the plant, with job security over the next 30 years. In total, this is expected to increase household income in the region by around A\$4-5million/y."

"Our company has extensive experience in renewable energy," Rizza said. "We are involved in major projects in several countries, including wind farms in South Australia, WA, USA, Spain, Germany, Portugal and France. We are also involved in a number of other wood-waste power plants in Australia."

BIOMASS IN BRIEF

Report: US biofuel technology in lift-off

Over the last six years, a total of 2,796 biofuel related patents were published in the US, with the number increasing by over 150% in each of the past two years. In 2007, the number of biofuel patents (1,045), including biomass, was more than the combined total of solar power (555) and wind power (282) patents published in that year. This was the finding from a report by US legal firm Baker and Daniels.

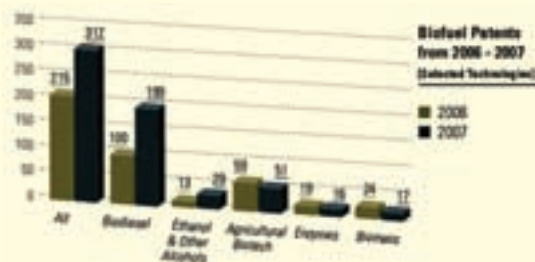
The number of patents published from 2006-2007 over technologies covered in the report were; biodiesel (299), agricultural biotechnology (110), ethanol and other alcohols (42), biomass (41), and enzymes (35). The five countries, by location of the patent owning entity, with the highest number of biofuel patents over 2006-2007 were the US (184), Germany (34), Japan (14), Italy (10) and France (10). In the US alone, the patents were owned by 78 different entities. In Germany, Japan, Italy and France, the corresponding numbers was 14, 12, 14 and five.



“Our review has left us with the following impressions. First, if we assume that biofuel, solar power and wind power are the leading renewable energy technologies, then in 2007 biofuel patents clearly dominate renewable energy, in terms of sheer numbers,” Baker and Daniels stated. “Moreover, if we assume that biodiesel and ethanol and other alcohols are the leading biofuel technologies, then in 2007 biodiesel came in first place, with ethanol and other alcohols being a far second.”

“Looking to the future, as venture funding and government funding inside and outside of the US increases, we expect that the number of biofuel patents will continue to grow steadily. In the US alone in 2007, venture entities invested \$2.9 billion into the biofuel industry. This amount is expected to increase significantly within the country and around the world in the coming years.

“In addition, the US Federal Government has allocated, for 2008 to 2015, \$500 million in grants under the Energy Independence and Security act of 2007 to promote the development of advanced biofuels. We also expect that the number of agricultural biotechnology biofuel patents will significantly increase in the coming years as transgenic plant technology is directed to biofuel applications.



“In the future, we also expect that legislation directed to climate change will strongly influence biofuel patents. For example, the recently enacted Energy Independence and Security act of 2007 requires that 16 billion gallons (more than 60 billion litres) of US transportation fuel be cellulosic biofuel by 2022. The

act requires that by 2022, 21 billion gallons (almost 80 billion litres) of US transportation fuel be derived from sources other than traditional ethanol biofuel.

“Accordingly, in the coming years, we expect to see an increase in cellulosic biofuel patents, and we also expect that traditional ethanol biofuel patents will continue to lag behind biodiesel patents in the future.”

Metso strengthens biomass drying technology

Finnish paper company Metso Paper has acquired a global full product licence for the Swiss Combi belt dryer, Kuvo, in a bid to increase the offering to customers on the growing biomass utilisation market. The agreement covers the area of pulp and paper making and in power generation, according to an online news service.

The Kuvo belt dryer is able to utilise various low-temperature heat sources. Its drying process is gentle to the product and it has high availability and high capacity. The dryer fits well into Metso’s biomass utilisation product portfolio and promotes the expansion on the growing bioenergy generation markets.

Swiss Combi is a 50-year-old Swiss engineering company that specialises in the development, construction and custom realisation of industrial dryers for biomass. Metso is a global engineering and technology corporation with 2006 net sales of approximately €5 billion.



Our Sweden office is already working in Russia so we will use them as a springboard into Russia too



“Because we have a lab that allows us to dial-in a very accurate and final specification, we are confident in what we give our customers,” Sublett said. “Size and tonnage are the two most critical items. Once we have that we look at what the infeed size material is.

“If we have large cuts like cants, that will play a role in the size of the machine because we need to have enough hammer-weight to destroy that piece. Or, if a pre-chipped material at 6-inch (15 cm) minus is brought in that needs to be ground to a 0.5-inch (1.25 cm) minus then we have to size the machine tighter to make sure we get everything through, which means it will dwell in the machine longer. If you want to feed a large amount of material through quickly to produce that small an end product you need a big machine.”

GOING GLOBAL

Jeffrey is a household name in the size reduction industry in North America where it does 80% of its business. But Sublett recognises the need for expansion and the opportunities available in international markets, particularly Europe as highlighted by the Green Circle and Dixie wood pellet projects. This was part of the reason behind the company’s acquisition of Rader Companies in September last year for almost \$16 million (funded by K-Tron). Rader manufactures and markets pneumatic conveying systems, screening equipment, engineered storage and reclaim systems, and truck dumpers for processing bark and wood chips for the global pulp and paper and forest industries. The company is based in Georgia but it has a headquarters in Stockholm, Sweden. Jeffrey intends to use that European base to increase its business in Europe and Russia.

“We’re already global in a lot of other product areas more so than the wood hog industry, but I think there are definite needs in Europe for our type of product and I think we can penetrate that market through the Sweden office,” Sublett said. “Our Sweden office is already working in Russia so we will use them as a springboard into Russia too.” **IF**