Energy Efficient Animal By-product Processing

Summary

- **Envacet, former Agritec Systems Limited (ASL), has developed and patented a novel solution for the energy efficient processing of Animal-By-Products (ABP). The ASL system simultaneously separates the ABP into solids, heavy liquid (water), and light liquid (tallow/oil) at low temperature.**

- **The ABP processing takes the ABP material and unusable animal products from abattoirs, processing them to return valued outputs - namely protein solids and tallow/oil.**

- **The project objective was to adapt the ASL process and demonstrate that it can substantially improve the energy efficiency of the processing and disposal of whole dead animals from the UK fallen stock processing industry.**

The Industrial Energy Efficiency Accelerator (IEEA)

The IEEA programme supports the development of innovative technologies that will help industry reduce energy consumption and cut carbon emissions. It focuses on innovations with large potential cross-sector energy and carbon reduction impact - either new technologies or established technologies applied to new sectors. Over £15 million in public and private funding has been committed to develop solutions through partnerships between technology developers and industrial companies willing to test technologies on-site. The programme is funded by the UK government (BEIS) and managed by the Carbon Trust, with support from Jacobs.

Introduction

- Envacet has developed and patented a novel mechanical separation solution for the energy efficient processing of Animal-By-Products (ABP), taking waste and unusable animal products from abattoirs and processing them to return useful outputs such as protein solids and tallow/oil. The ASL system simultaneously separates the material into phases: solids, heavy liquid (water), and light liquid (tallow/oil) at low temperature. This is a highly regulated industry, dominated by the rendering industry in the UK. Traditional rendering methods use high temperature and pressure to boil the raw material and evaporate all the moisture contained in the ABP and dry the material, which is very energy intensive. This case study sets out the performance demonstrated during the project and compares this with baseline rendering industry figures established from published literature.

- Historically, there have been limitations on the materials the ASL plant can process which have restricted the use of the technology to processing material that consists mainly of soft tissue and soft bones.

- The aim of this project has been to extend the ability of the ASL plant to be able to process mature animals from different species (fallen stock) which contain hard bone and a higher percentage of protein solids. To this end ASL has partnered with Edge Close Green Energy to adapt the existing technology to cover this application.

- The project partners are:
    - Envacet. Specialist engineering company and developer of the technology who are based at Markham Vale, Chesterfield, Derbyshire.
    - Edge Close Green Energy Limited – Operator of the site in Flagg, near Buxton, Derbyshire.

The total BEIS funding for the demonstration project was £644,085.81. It allowed the project partners to develop and adapt the existing technology in order to be able to process fallen stock.

About the innovation

The novel processing method already developed by ASL is described below -

- The machine is designed to process soft material (meat/intestinal trachea etc) through one in-feed system and soft bone material through a second in-feed system.
- The soft material enters the machine via a metal detector and is minced in a 200mm mincer to a maximum of 6mm particle size.
- The soft bone material is processed through a small breaker and an emulsifier.
- The 2 streams are mixed together and water is added from the centrifuge.
- The mixture is then pumped by pipe to the kettle for heating to 80C.
- From the kettle the material is pumped to a sealed continuous cooker and is stirred for 20 minutes in the continuous cooker, while being maintained at 80C.
- From the continuous cooker the material is pumped to the decanter centrifuge.
- The centrifuge is a specially designed Hiller type DO series three-phase decanter that separates the slurry into protein solids, water waste and oil.
- The solids are discharged via a progressive cavity pump to a sterilizing cooker that processes the proteinaceous solids as per the requirement of EU directive EU1774/2002 method 5.
- The water is discharged by pump to effluent treatment.
- The tallow is pumped from the centrifuge to a separate storage tank via a centrifugal pump.

- The entire process is controlled by a computer (PLC). The PLC uses sensors within the machine to maintain product quality and efficient running. The PLC incorporates process start and stop programs as well as monitoring the performance of the centrifuge. The process start program brings the machine up to working temperature and starts the various components in sequence to check their operation. The system stop program incorporates a cleaning sequence that makes sure the machine is available for start up when necessary, with no operator involvement needed in cleaning. The PLC uses a waterproof touch screen to provide the operator interface and information on operation. The operator, using the PLC, can set various parameters and also a provision is made for data logging from the PLC.

The development that was undertaken during the project has addressed the following problems:

- The ability to size reduce the hard bones that are found in the skeletons of mature animals.
- The removal of the hard bone particles from the product stream to avoid premature wear and damage to the decanter centrifuges.

The demonstration

The process is installed at the site of Edge Close Green Energy Ltd which is located in the village of Flagg in Derbyshire. The project required the development of a size reduction system to enable it to process complete animals with the minimum of preprocessing. These animals contain soft material, soft bone and hard bone.

Size reduction could not be carried out in a single stage. A size reduction process was designed that uses 2 steps.

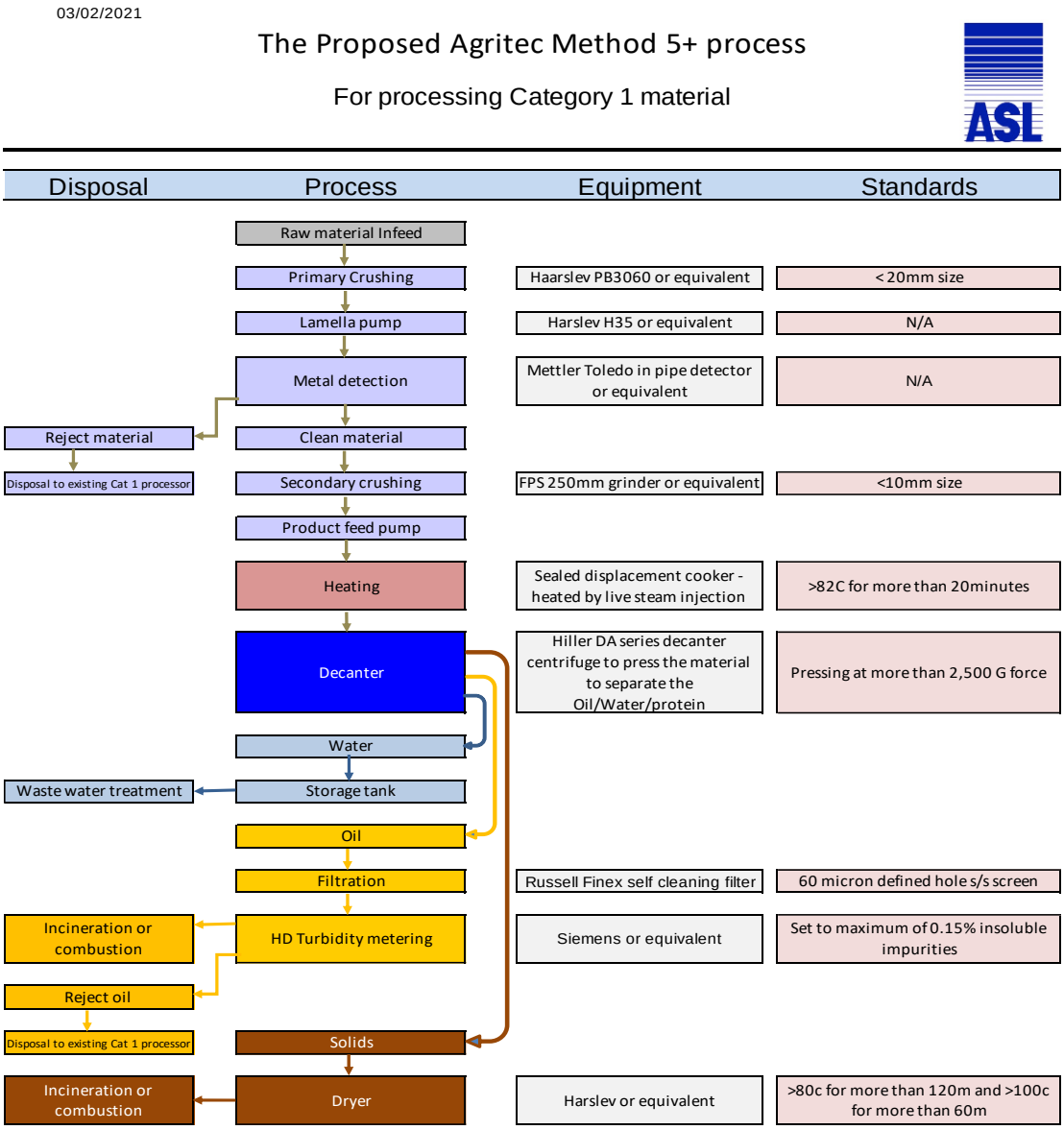
- Step 1 - is the use of a single shaft crusher to break the material into pieces of less than 20mm. A mechanical handling system was designed to move whole animals into the crusher, to recirculate the material back through the crusher and then to transfer the resulting material into the secondary size reduction system.
- Step 2 – the secondary size reduction system consists of mincers to reduce the material down to less than 10mm. The mincers are fed by taking material out of the recirculation loop as each mincer empties its infeed hopper.
- Control – an automatic control system has been designed and installed that maintains a continuous flow of material from the size reduction processes to the separation process. This is controlled by a PLC.

Raw material and Crusher

Separation and centrifuges

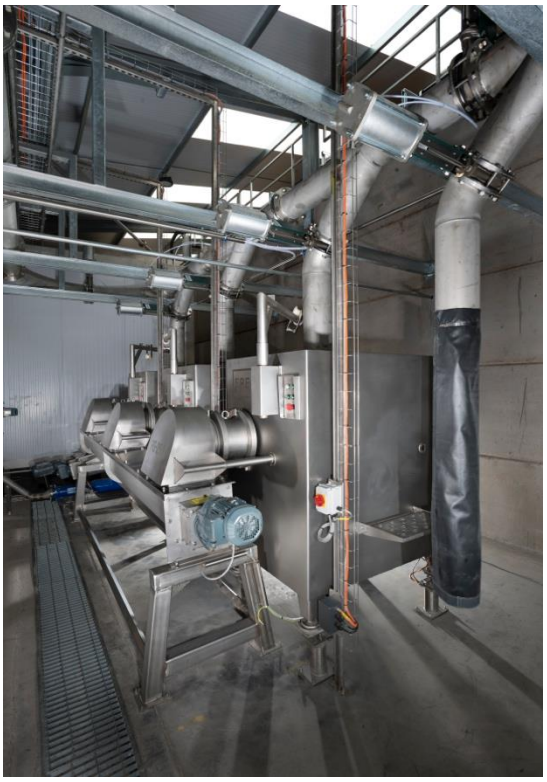
Process flow diagram

The diagram below shows the process flow for handling Category 1 animal by-product material.



The layout

These images illustrate the size reduction process and the separation process.



Size reduction mincers

Hard bone separation and control

Monitoring and Results

The entire process has been monitored using an onboard SCADA system.

The performance data for the whole trial period is summarised below:

Input weight	290,180	kgs	
Oil produced	27,116	kgs	9.4%
Protein produced	208,497	kgs	71.8%
Waste water	54,567	kgs	18.8%

The overall mass balance including added water:

Oil/tallow	27,116	kgs for power generation
Rejected material	5,853	kgs to renderer/disposal
Protein solids including added water	132,640	kgs to renderer/disposal
Hard bone including added water	70,004	kgs to renderer/disposal
Water	356,454	kgs for disposal

During the trials the protein solids output were sent for disposal at a conventional rendering plant.

Energy savings calculations

The energy inputs for the period are electrical energy and thermal energy. They include the start-up and clean in place (CIP) energy usage.

Baseline data			
Thermal energy input requirement (Steam)	-	380	kWh/t
Electrical energy input requirement	-	70	kWh/t
Envacet plant data			
Thermal energy input requirement (Steam)	-	82	kWh/t
Electrical energy input requirement	-	22	kWh/t
A reduction of the energy requirement of -			
Thermal energy input requirement (Steam)	-	78.4	%
Electrical energy input requirement	-	68.3	%
Total energy input Baseline(1)	-	450	kWh/t
Total energy input ASL Plant	-	104	kWh/t
ENERGY INPUT REDUCTION OF	-	76.9	%

Baseline Performance

The project is measured in terms of specific energy consumption against the baseline performance of a traditional rendering plant kWh/t.

The baseline performance figure has been established using documented performance as referenced in published literature.

The ASL data is based on an average across daily run data.

Future impact

With the success of this project ASL have been able to demonstrate the capabilities of the system to process complete carcasses from fallen stock.

In the Short term –

The target sectors will be other abattoirs, with one abattoir customer near to confirming an order to be operational before the end of the year. This plant will potentially reduce the abattoir's emissions by 49 tonnes of CO_2 per week. With the lifting of Covid-19 travel restrictions ASL will progressively engage with other abattoirs in the UK to gain new business. Within the next year, ASL see an opportunity for 3 – 5 plants in the meat industry processing 45,000 tonnes of ABP waste per annum.

Medium to Long term –

With marketing support from the IEEA team, ASL intend to develop a strategy for approaching the major supermarkets and QSR's (quick service restaurants) in the UK leading to a mass rollout across their supply sites. The adoption of this technology across their supply chains can offer a very fast payback as well as reducing the carbon footprint of suppliers. At the same time, with the advent of Scope 3 reporting this will also help them to reduce their exposure to any carbon reduction taxes or regulation that might arise as a result. ASL anticipate that, with the widening of the market into Fish and Processed food waste etc, there is an opportunity within the UK alone of circa 50 plants in the following 5 years.

Innovation lessons

Participation in the BEIS energy efficiency accelerator program has been instrumental in speeding up the development of this technology to allow it to be used across a wider sector of industry.

This will lead to a timely roll out of the technology within the UK food supply chain.

Contact information

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Industrial Energy Efficiency Accelerator delivered and supported by:

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