Electricity Distribution

Active Creosote Extraction (ACE)

EIS Project Overview Presentation

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29/10/2024

nationalgrid

What is creosote?

What is Creosote?

- Hydrocarbon based preservative
- Very effective, but comes with a multitude of health hazards.
- Banned in 2003
- Limited use cases in industry currently.

Land contamination

Hazardous material

Skin irritant

Current Methods of Poles Disposal

There are currently two methods NGED use for pole disposal. Landowners and through waste contractors.

Landowners

- Option to leave poles with the landowner
- Can ONLY be given to the landowner on whose land they originally stood.
- Eligible for poles constructed before June 2003.

Waste Contractor (Incineration)

- Incineration arrangements are then made.
- Sent to an incineration facility in South Doncaster.
- 716 tonnes incinerated in 2023 from NGED alone.

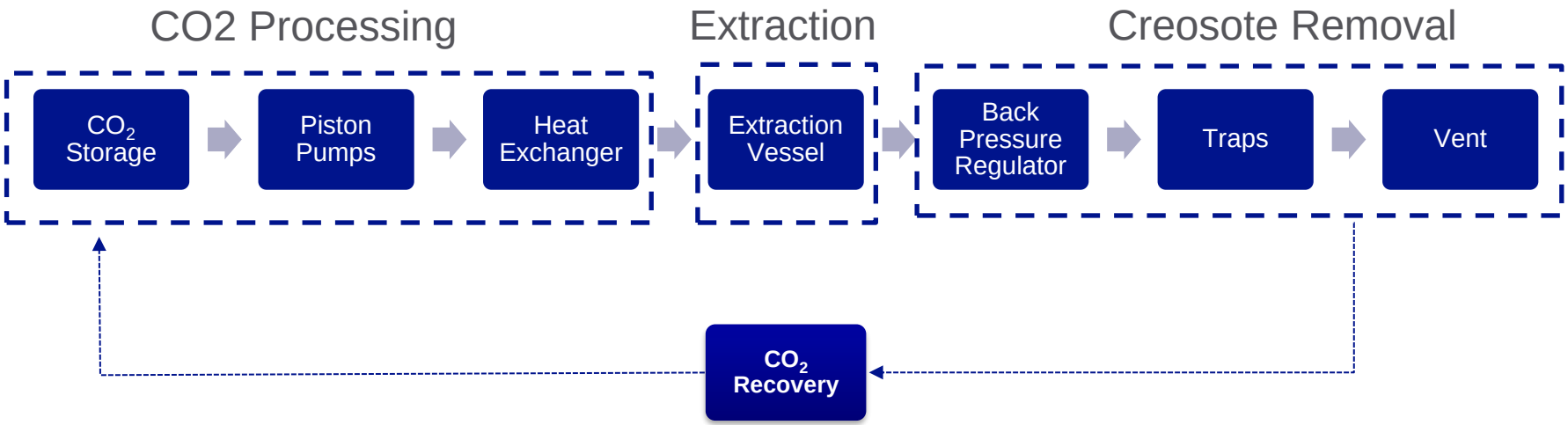
New product required?

- Landowner ship is regularly questioned
- Incineration is unsustainable
- How can innovation address this?

Project Overview

- Funding: Network Innovation Allowance (NIA)
- Budget: £1.47m
- Timescales: November 2021 – March 2024
- Partners: GPT Environmental

Extraction Process



There are four main types of test methodologies that were pursued:

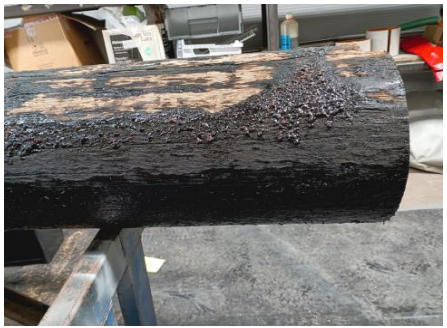
Pressure and flow dependence	Pulsed	Acetone modifier 1 & Methanol modifier 2
• Uses pressure, temperature and flow rate as variables. • The ‘baseline’ extraction technique uses no modifiers or additional equipment.	• This technique uses a pressure accumulator • Assists in mass transfer from pole. • Created by pressure differential within vessel.	• Co2 modified with chemicals • Alters the solubility and surface tension • Potentially increase the mass transfer of the creosote out of the wood. • This could improve efficiency.

Initial Testing

The first test pole under operating pressure showed early insights into creosote content before and after extraction. Plenty of learning came out that shaped future work.

CO_2 was NOT continually flushed, meaning saturation was introduced (similar to a sponge holding water). An estimated **kilo** of creosote was removed.

The core of the pole is already deemed non hazardous waste. Therefore, poses wasted mass when it comes to testing. Testing on chipped wood, allows for a greater surface area, averaged out creosote concentration and higher extraction efficiency. This was taken forward to later work packages.



Creosote deposit post extraction

Sample (depth)	Pre extraction concentration (mg/kg)	Post extraction concentration (mg/kg)	Reduction (%)
45-60mm	830	74	91
30-45mm	55	482	-776
15-30mm	12301	1773	86
0-15mm	14283	3407	76

Close to our target!

Levels increased from before!

Key Message: The underlying principle was proved, but there was a lot to investigate and focus on.

Methodology Testing

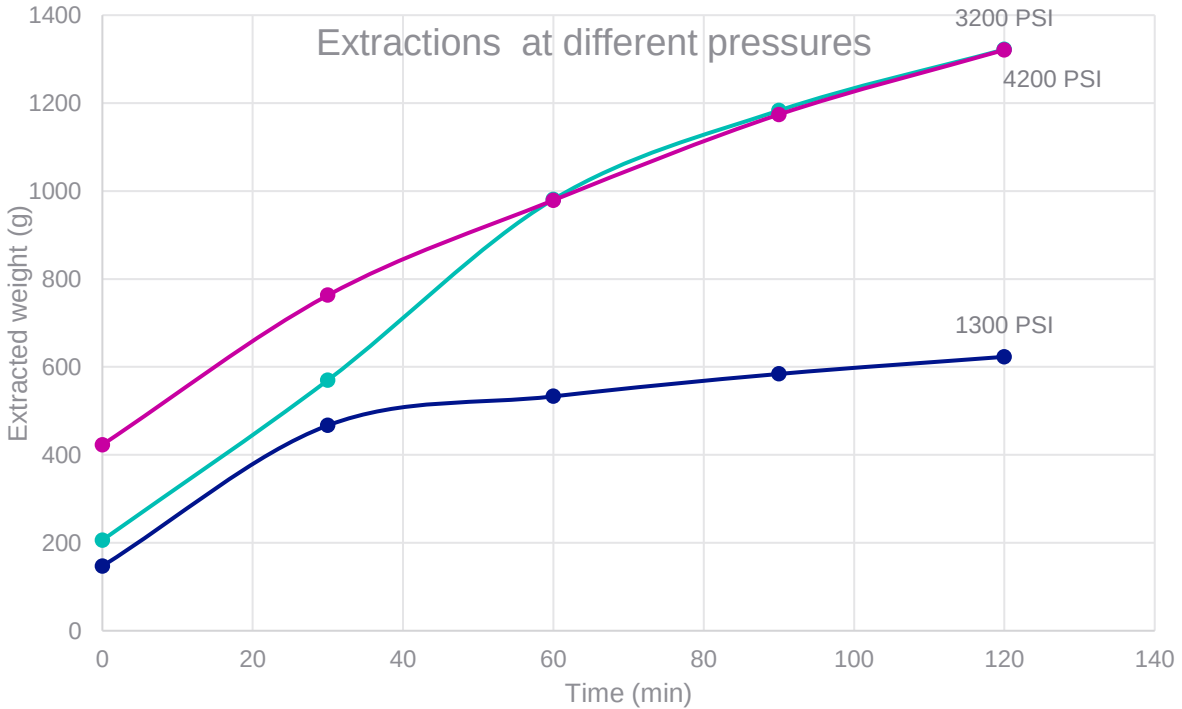
Each Methodologies were extensively tested on 2.5m pole samples with varying effectiveness. The highest extraction efficiency was seen to be 89% but varied from pole to pole due to differing pole age, state and creosote content. It was decided to focus on chipped wood rather than 2.5m poles due to a more reliable service.

Extraction method	Extraction Duration (min)	Sample ID	Average extraction efficiency	Pre extraction concentration (mg/kg)	Post extraction concentration (mg/kg)	Extraction efficiency for selected example
SFE	60	400-1	16%	5330	3536	32.8%
	240	400-1	35%	4373	2793	35%
	60	400-2	63%	4003	1055	71.2%
	240	400-2	59%	3631	1333	61%
	60	400-3	50%	5159	1360	71.4%
	240	400-3	47%	5159	1632	66.6%
	60	400-TEST	37%	4853	2512	46.9%
	240	400-TEST	48%	3073	552	86%
Pulsed SFE	120	500-1	63%	5375	1374	80.6%
	120	500-2	56%	5682	2867	61.7%
	120	500-3	59%	4253	1161	69.1%
	240	500-TEST	57%	2911	1356	53.4%
	120	800-7	48%	11348	5593	51%
	120	800-8	81%	17206	1816	89%
	120	800-9	60%	16668	6544	60%
Methanol modified	120	800-1	66%	7974	2377	70%
	120	800-3	47%	11224	5072	47%
Acetone modified	120	800-4	29%	8122	5615	31%
	120	800-6	15%	9748	8069	17%

Key Message: The technical process was worked, but in areas the removal efficiencies were not good enough.

Carbon Recovery Testing

The CO2 recovery unit was integrated into the design in order to recycle the CO2 used during the extraction process. The unit procured had its own extraction vessel, capable of accepting wood chippings at increased operating pressures (4500PSI).



The system managed to get extractions at or below the target of 1000 mg / kg. with a lowest value of 350 mg /kg.

Per 10kg sample, over 1kg of creosote was regularly removed.

The fundamental next step is to achieve this in a reasonable time standard.

Additional research around this area is needed to reach commercial levels.

Testing, Learning & Evolution

Initial Testing We designed the trial plant based on a theory from academia. The first test pole under operating pressures showed early insights into creosote content before and after extraction. Several learning points came out that shaped future work. The success of theory was first proved in this stage.

TRL Before: **2** TRL After: **4**

Methodology Testing Each of the methodologies were extensively tested on 2.5m pole samples with varying effectiveness. The highest extraction efficiency was seen to be 89% but varied from pole to pole due to differing pole age, state and creosote content. It was decided to focus on chipped wood rather than 2.5m poles due to a more reliable outcome. At this stage we proved that pulsed extraction was the most effective, but the plant design would limit the speed of pulsing.

TRL Before: **4** TRL After: **5**

Carbon Recovery Testing High pressure (4500PSI) liquid CO2 in a closed loop is a key part for the process. Because we want the process to avoid leaking CO2, we needed to show that we could avoid venting this gas. Using the CO2 recovery method, we demonstrated that we could extract to beneath the target of 1000 mg / kg. with a lowest value of 350 mg /kg.

Per 10kg sample, over 1kg of creosote was regularly removed.

TRL Before: **5** TRL After: **6**

Next Steps Further additional research is needed in order to increase the TRL to a stage where it is demonstratable and operational under industry relevant conditions. The main investment would be used two fold:

- Investment in additional equipment to reduce extraction times (by increasing pulsing speed) and subsequent operating costs.
- Commercialisation plan, creating a roadmap for rollout.

TRL Before: **6** Expected TRL After: **8**

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