Dealing with a problem feedstock

Using IFBB as a Biomass upgrading tool:

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Mission impossible?

- After the visit of Blue Conrad to North Wales in Feb 2014, we were approached by a Welsh government official.

- He said that they had a problem that was raising ‘concerns’ and wondered if this was a job for..... **IFBB !**

The problem.

- In December 2013, The environment Agency published an Evidence Document that highlighted the high and variable levels of potential toxins in untreated road leaf sweepings.
- The clear advice given was that this material could no longer be used in high quality compost production.
- The material could be used to produce a CLM only, and the future of even that was in doubt
- Advice to LA's was to sweep the material into the gutter and let it decay in situ.
- EA and NRW are rightly adopting the precautionary principle – onus is on others to provide good evidence-based research.

Environment Agency

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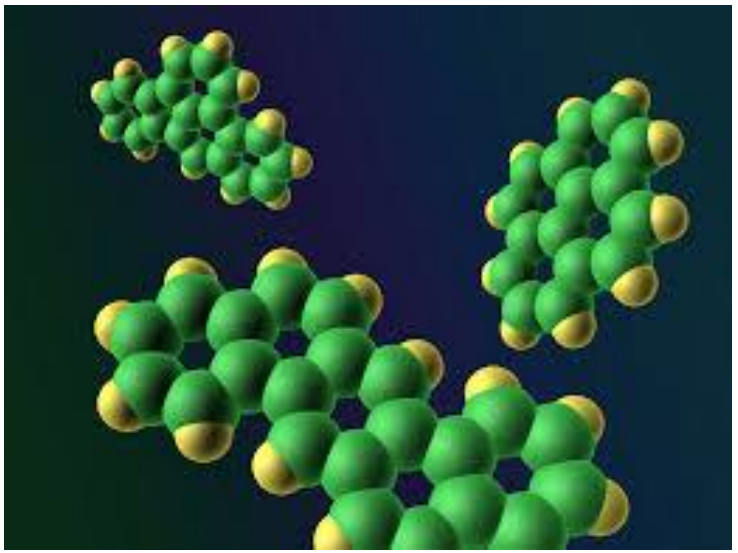
The potential impacts

- Welsh Local Authorities were concerned that they would no longer be able to compost the <60kTpa of leaf sweepings.
- If this material had to go to landfill, the disposal costs would be ~£100/T
- If an inability to compost the material meant that the tonnage could not be used for LATS, it might affect the LA's recycling and composting performance.
- WG has set a statutory diversion target for municipal waste of 70% by 2025. Wales leads the UK in recycling performance and is 4th best performer in the EU, ahead of Switzerland.
- As average diversion levels move above 60%, every 1% extra becomes harder to find, and potentially more important.
- The issue was to discover if Welsh LA's faced increased costs of up to £6m a year, or if there was a way around the problem.

What are the contaminants?

- PTE's : Heavy metals such as Zinc, Cadmium, Nickel, Arsenic, Copper, Mercury etc. as well as 'rare metals' such as Rhodium and Palladium
- These come from vehicle traffic and historical industrial emissions.
- Polycyclic Aromatic Hydrocarbons (PAHs). These are large hydrocarbon cluster or chain molecules such as Benzo[a]anthracene, Chrysene, Benzo[a]pyrene, Coronene etc. They are potentially carcinogenic and mutagenic. Sources, incomplete combustion, petrochemicals, historical industrial emissions.
- Both groups are potentially cumulative.



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Why look at this material?

- Cwm Harry were asked by Cyngor Gwynedd and WRAP Cymru to consider two different aspects to the problem:
  - Investigating whether one or more environmental factors affected the concentration and distribution of contaminants.
  - Seeing if a remedial treatment regime – including IFBB - might mitigate the problems.
- Combine partners (particularly Uni Kassel) had identified leaves as a potential feedstock for IFBB plants – however, these were from parks and gardens.
- With the IFBB process being new to the UK, what was needed was a looming problem that it could solve. We thought that a potential cost avoidance of <£6m per year might win IFBB the attention and support it needed to get a foothold in Wales.

Phase 1: Looking at the environmental factors

- We looked at a number of factors to see if there was any obvious correlation between levels of contaminants and another factor.
- 72 Sample sites selected across Arfon district in Oct/Nov 2014.
- Multiple replicates were taken at each site to give a representative response.

Getting a representative sample set

- Road types: A/B/minor
- Urban/rural locations
- Manual & mechanical collection methods
- Different traffic densities.
- Different levels within the leaf pile.
- Subject to spray/run off or dry
- A control site from a farmer's field.

Typical collection methods

‘Scarab’ collection equipment

‘Scarab’ load chamber

Comparing theory with real life

- We realised that there was a huge difference between carefully collecting a section of a leaf pile with hand tools and using a road sweeping vehicle.
- Cost, time, practicality, road safety.
- Scarab's pick up head can be manipulated to give selective pick-up.
- Mechanical collection unavoidably co-mingles and further contaminates the material.

Environmental factors – our hypothesis

- At the outset we postulated that certain factors might influence the distribution of contaminants and if we could correlate these, a selective collection regime might avoid ‘hotspots’:
  - Rural areas and quieter roads might show less contamination – spatially targeted collections
  - Metals might be primarily close to the road surface and only mobilised by water into the leaf pile - adapt pick up head and avoid brush and water spray, or sweep streets prior to leaf-fall.
  - PAHs may be being mobilised by water run off and spray.
  - The control site would show virtually zero contaminants.

Phase 2: Mitigation and treatment

- Assuming that it would be impractical to radically alter existing collection regimes:
  - Took samples from suspected high contamination area.
  - Mechanical collection method with definite co-mingling effect.
  - Looked at accepted remediation methods already in use.

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Existing treatments

Composting: bacterial degradation of PAH's

Hydro-Mechanical separation

Applying the IFBB process

- Ensilement.
- Maceration.
- Mashing

Material properties varied widely

Separating solid and liquid phase

Screw press separation:

Anaerobic digestion of liquor

Preparing press cake for further processing

Drying press cake

Torrefaction and Pyrolysis

Pyrolysis was undertaken by IBERS at Aberystwyth on their tube furnace with temperatures of 300°C and 530°C under Nitrogen

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Remediation steps – our hypothesis

- The literature demonstrates that Composting and AD can dramatically reduce PAH levels.
- Hydro-mechanical separation techniques demonstrate that organic, heavy and fines fractions can be separated, and PTE's trapped in the ceramic filter (though leaves don't survive)
- We postulated that :
  - metals would be found in the grit and debris comingled with the leaves by collection
  - Metals would follow the fines in the liquid phase
  - PAH's would adhere to the solid phase and end up in the press cake.
  - Pyrolysis would break down most PAH's under the right conditions.

Were we right?

- Can contaminants be avoided by selective collection based on contamination mapping or use of a selective collection regime?
- Can a simple pre-treatment such as a cold-wash be developed that would allow continued composting to be safely undertaken?
- Are leaves from road-sweepings a viable feedstock for the IFBB process on their own in terms of energy yield?
- If composting has to be abandoned, can leaf-derived press cake be upcycled into a post-waste product or storable fuel medium?

Under Wraps

- If you would like a copy of the report when it is published, please leave your contact details with the conference organisers.

Leap Environmental report for Surrey County Council

Available in .pdf format

- An Investigation on Surrey's Road Swept Leaves for Surrey County Council
  Report Reference : LP00828
  Report Date : 16 March 2015

Extract from Surrey report conclusions

"The results were then compared with relevant Assessment Criteria based on risk to human health and they have indicated that heavy metals and PHCs do not present such a risk. In addition asbestos was not identified and therefore also does not present a risk. The results for BaP were statistically assessed as one sample exceeded the higher assessment criteria used (the C4SL). The maximum value recorded at 14.6mg/kg represents 0.6% of the dataset. This value is shown to be statistically significant but is not considered to be an outlier within the dataset. The upper bound estimate of the mean (UCL) was significantly lower than the C4SL and only slightly above the more conservative LQM GAC. Furthermore, the reproducibility of this dataset was such that it is considered likely that a similar distribution will be followed and small numbers of samples will be present with similar isolated elevated concentrations."

Diolch yn Fawr iawn
Thank you very much

- The Cwm Harry organic conversion team hope to get inventing on a possible solution soon.
- Watch this space.....