

From: [REDACTED]
To: [REDACTED] [REDACTED] [REDACTED]
Subject: FW: Experience and studies from Queensland on incineration of PFAS firefighting foams
Date: 27 October 2020 12:44:56
Attachments: [image005.png](#)
[image007.png](#)
[image008.png](#)
[image009.png](#)
[image010.png](#)
[SERDP2020-PFASDestructionHydrothermal.pdf](#)
[RoeschEtAl2020-PFASDestructionReview.pdf](#)
[MagaEtAl2020-PFASFoamWasteTreatment.pdf](#)
[LASTFIRE-PFASDisposal.pdf](#)
[image002.png](#)

Dear all,

I got feedback from [REDACTED] [REDACTED] on PFAS destruction methods and experience in Queensland with incineration of fire-fighting foams in cement kilns, which seems a promising method.

@ [REDACTED] Michael, could you please advise how to make it available to the relevant people of the universal restriction team?

Best regards,

[REDACTED]

From: [REDACTED] [mailto:[REDACTED]]
Sent: 27 October 2020 11:09
To: [REDACTED] <[REDACTED]>
Subject: RE: Experience and studies from Queensland on incineration of PFAS firefighting foams

Hi [REDACTED]

I am always happy to share experiences. I apologise if I missed your last email. Feel free to share any of my presentations. I am currently updating the disposal presentation with an overview of PFAS disposal for the Green Science Policy Institute webinar next week but it is much the same. I can share that shortly. [REDACTED] [REDACTED] [REDACTED] and I are also working on a PFAS disposal whitepaper for LASTFIRE that is a bit open-ended at the moment because of the lockdown.

The attached recent papers may be of interest in regards to destruction. The SERDP paper on hydrothermal destruction is interesting, the only thing I take issue with is the assertion that cement kilns use 1,336 kWh/m³ for PFAS waste (page 6) this is completely WRONG. In reality cement kilns do not need any extra energy beyond normal production, in fact the trials we ran in Queensland showed that the fluorine input catalyses clinker formation and can reduce fuel use. In other words there is no extra fuel cost for cement kilns with potential fuel use reduction. The safety margins for PFAS destruction and capture are huge under normal cement clinker production conditions, compared to hazmat incinerators where they may be tempted to run close to the limits to make savings. An option not explored yet as far as I know that may be effective is the use of calcium (lime) in hazmat incinerators to ensure PFAS destruction and capture.

Otherwise the hydrothermal method investigated by SERDP shows great promise as a potentially portable system for where cement kilns are not available. The review of destruction methods by

Roesch et al is an interesting summary of other methods.

- [Supporting documentation](#)

The cement kiln PFAS burning trials reports and results are subject to commercial sensitivities, however the critical aspects can be shared and are in my presentations.

- [How the PFAS foams concentrates and firewaters are handled in practice in cement kilns](#)

The concentrates or wash-waters can be introduced into either the calciner or the main burner. However, the water content can disrupt flame temperatures. So the best method for introduction is with it mixed in at low concentrations into “alternative fuel” (waste oil) that is fed in as normal fuel. The trials in Queensland ran quantities of PFAS at up to 0.5% fluorine concentration at a rate of up to 1 tonne per hour. This equates to 5kg of fluorine per hour. However, the kiln also destroys up to 325 kg of fluorine per hour in spent aluminium cell carbon (2.5 tonnes/hr) with no significant emissions of HF or PFAS (~0.05 mg/Nm³). So our 5kg per hour of PFAS fluorine with a destruction efficiency of 98% set in a licence condition is probably insignificant. PFAS can only be introduced when the kiln operating conditions are stable.

- [Cost of the incineration per kg of concentrate/firewater](#)

Cement kiln cost for destruction is reputedly \$6.50/L (~€4). Plasma arc destruction was about \$18.00/L (~€11). For dilute PFAS it is suggested that PFAS be concentrated by ion exchange resins, Perfluorad or GAC.

- [Air emission measurements results analysis of the cement kiln output products](#)

No PFAS were found in air emissions or the cement clinker in the trials. The 750:1 excess of calcium to fluorine and very long residence times progressively locks up the fluorine. HF measured at about 1/1000 of the licence limit of 50 mg/NM³ @7% O₂ regardless of whether there was 5kg PFAS or 325 kg of other fluorine inputs or not. Destruction efficiency was • PFOS DRE = 99.99993%, • PFOA DRE = 99.99975%, • PFHxS DRE = 99.99936%.

- [Enforcement: is there a maximum concentration of fluorinated compounds in the kiln fumes](#)

PFAS analysis for the stack gases is required periodically. No PFAS limits have been set. Monitoring assumes that HF will manifest first.

- [Any effect of the CaF₂ in the cement clinker?](#)

The cement clinker product quality is unaffected by the CaF₂ trace content, this is a normal part of cement production from fluorine in feedstocks like limestone.

- [Overall assessment of the technique by the authorities](#)

Overall the co-processing of PFAS in cement kilns is favoured as the safest and most sustainable option:

- Zero extra energy is required above that for normal cement production (some reduction in fuel use is even possible).
- Normal kiln conditions provide very large safety margins in temperature and residence times.
- Temperatures far exceed those needed for complete destruction (800-1600°C).
- Calcium catalyses PFAS destruction at low temperatures (from 350°C) 1100°C is not

necessary.

- Excess calcium (750:1) and long residence time ensure complete fluorine stripping.
- Fluorine is captured as calcium fluoride with a boiling temperature well above kiln temperatures so cannot off-gas.
- Fluorine progressive capture prevents PFAS reforming in the kiln cooling zone.
- Calcium fluoride is inert, non-toxic, insoluble as a trace in the clinker.
- No need to scrub stack gases, no ash, no fluorine waste, no effect on cement clinker quality.
- The use and presence of fluorine in cement production has been known and studied for decades.

I hope this helps. Stay safe.

Regards



Principal Advisor Incident Management

Central Queensland

Incident Response Unit | Environmental Services & Regulation

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From: [REDACTED] <[REDACTED]>

Sent: 26 October 2020 17:17

To: [REDACTED]

Subject: FW: Experience and studies from Queensland on incineration of PFAS firefighting foams

Dear [REDACTED]

Sorry to bother you about this but we are now starting the official regulatory process of restricting PFAS-based fire-fighting foams in the EU and information about the safe disposal of these and your experience in this regard would be very valuable for us. Do you have further information like I listed below that you can share with us? Also, can I circulate the presentation you made at the Lastfire webinar?

Thanks a lot!

Best regards,



Scientific officer

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From: [REDACTED]

Sent: 30 September 2020 12:08

To: [REDACTED]

Subject: Experience and studies from Queensland on incineration of PFAS firefighting foams

Dear [REDACTED]

Hope you are doing fine. I listen to your presentation a few weeks ago at the Lastfire webinar. I found it extremely interesting, especially the part related to Queensland's experience on incinerating PFAS firefighting foams in cement kilns.

As you know, the EU is putting additional regulatory pressure on PFAS foams and the fate of these if a ban is imposed is particularly important. In this regard I would be particularly interested if you have any data, report or studies related to Queensland's experience in incinerating PFAS firefighting foams in cement kilns, e.g.:

- Supporting documentation to Queensland's requirements to incinerate PFAS foams in cement kilns
- How the PFAS foams concentrates and firewaters are handled in practice in cement kilns for destruction (e.g. flow rates of PFAS-material feeding into the kilns, typical maximum hourly capacity of a kiln to incinerate PFAS concentrates/firewaters)
- Cost of the incineration per kg of concentrate/firewater
- Air emission measurements results (any fluorinated gases detected?), analysis of the cement kiln output products for fluorinated compounds content
- Enforcement: is there a maximum concentration of fluorinated compounds in the kiln fumes to confirm that a "full" mineralisation has taken place (if yes, which threshold, which F compounds, which analytical method)
- Any effect of the CaF₂ in the cement klinker?
- Overall assessment of the technique by the authorities
- Any other relevant information?

Happy to hear back from you!

Best regards,

[REDACTED]

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