

Mechanochemical Destruction of PFAS in AFFF and AFFF-Impacted Soils

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Environmental Decontamination Limited



What is Mechanochemistry?

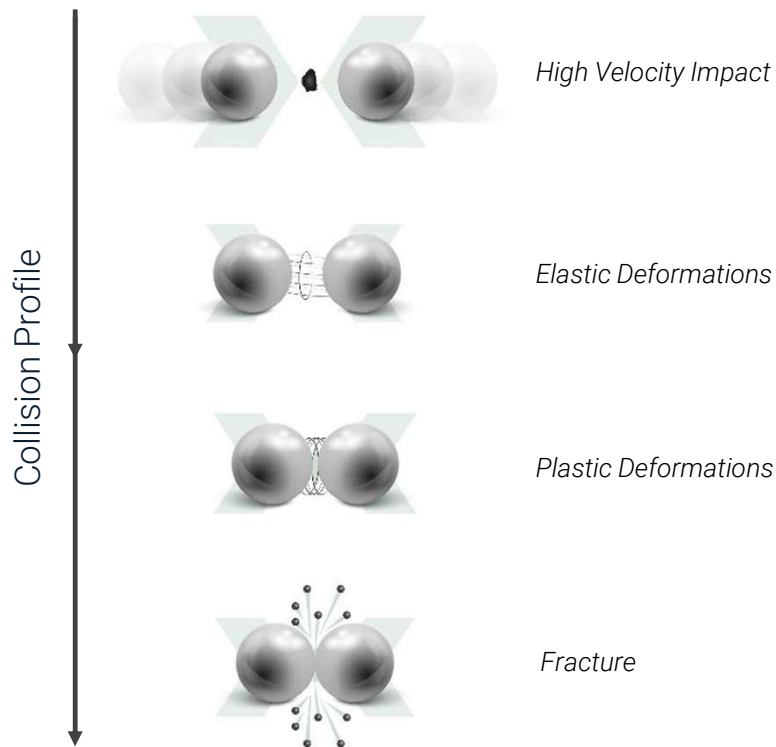
- Mechanochemistry is a less well-known division of chemistry that explores the physical and chemical transformation of substances that have been mechanically stressed or have undergone mechanical fractures



Pre-history

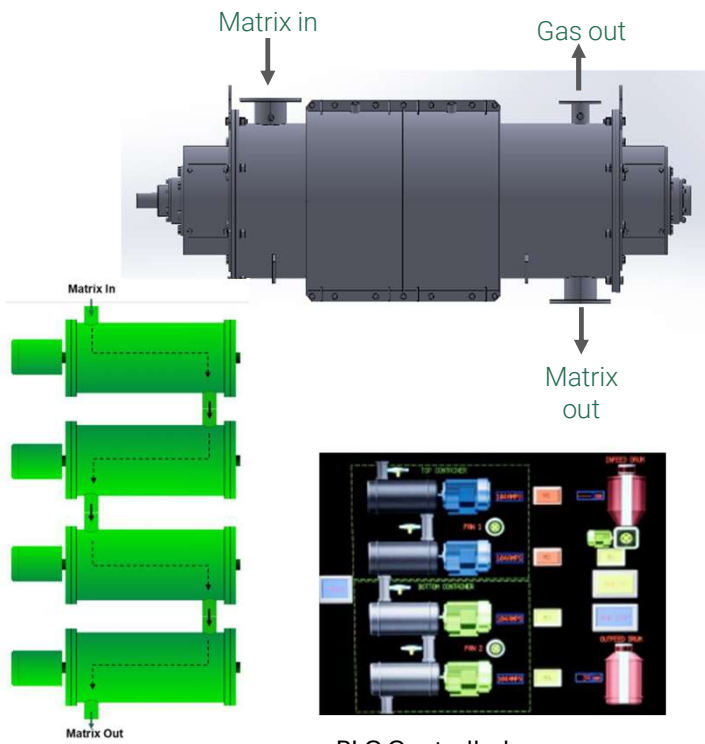
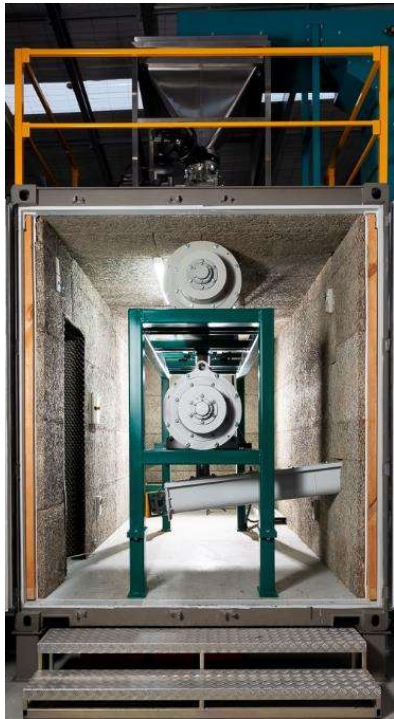
Modern day

EDL's Mechanochemical Destruction (MCD) Technology



- Ball bearings in reactors collide at incredibly high velocities
- Mechanical energy induces physical and structural transformations
- Particles are subject to intense conditions at the point of collision
- Optimizing mechanical activation results in improved destruction of target organics

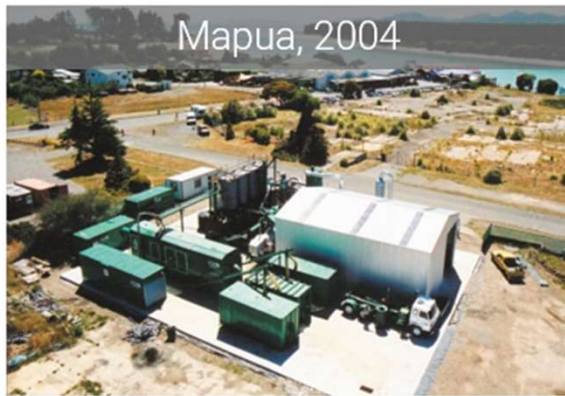
EDL's Mechanochemical Destruction (MCD) Technology



PLC Controlled

- Patented technology is a proven high efficiency ball milling system
- Engineered to destroy organic pollutants and asbestos in solid matrices
- Focused on sustainability and providing industries with a greener solution for waste

EDL's Evolution



EDL's Portfolio to Date

- **Persistent Organic Pollutants**
 - Destruction of all legacy hazardous organics
 - Currently demonstrating capability to destroy PFAS in soil, AFFF concentrate, and treatment residuals
- **Asbestos**
 - Recycle asbestos containing materials
- **Materials Processing**
 - Transforming low value materials into high value powdered products
- **Nuclear Waste**
 - Development of mechanochemical solutions for nuclear waste including liquid organics, asbestos, and sorbents
- **Illicit Drug Destruction**
 - Seized contraband

EDL Technology Center: Auckland, New Zealand



EDL Discriminators

> 20 Years of Experience



Pioneering the Science



Ability to Scale



Research Workflow for New Applications

Benchtop



- Mechanisms and kinetics
- Byproducts

Intermediate



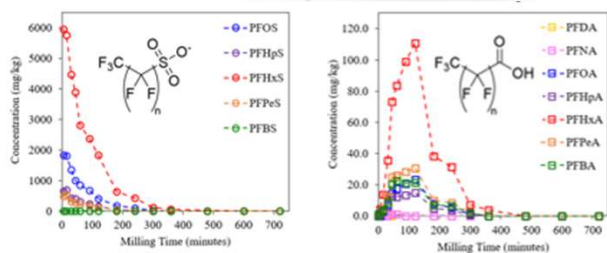
- Batch (10-20 kg)
- Operational optimization

Demonstration



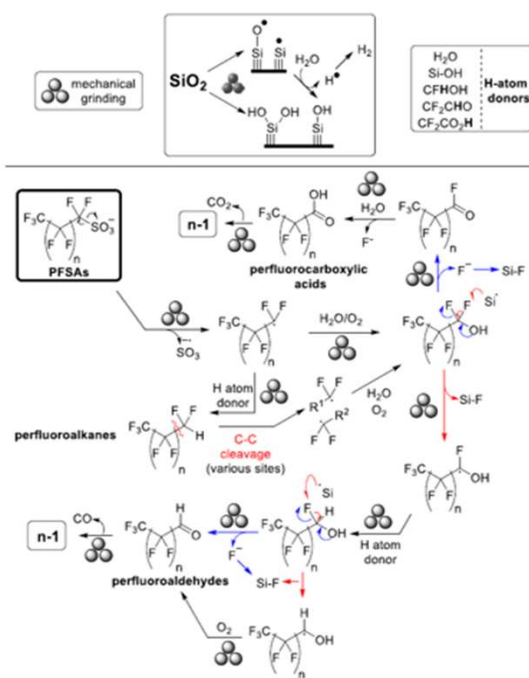
- Continuous (0.5-2.0 t/h)
- Technoeconomic info

EDL's Bench-Scale PFAS Results to Date



Gobindlal et al. 2022. ES&T

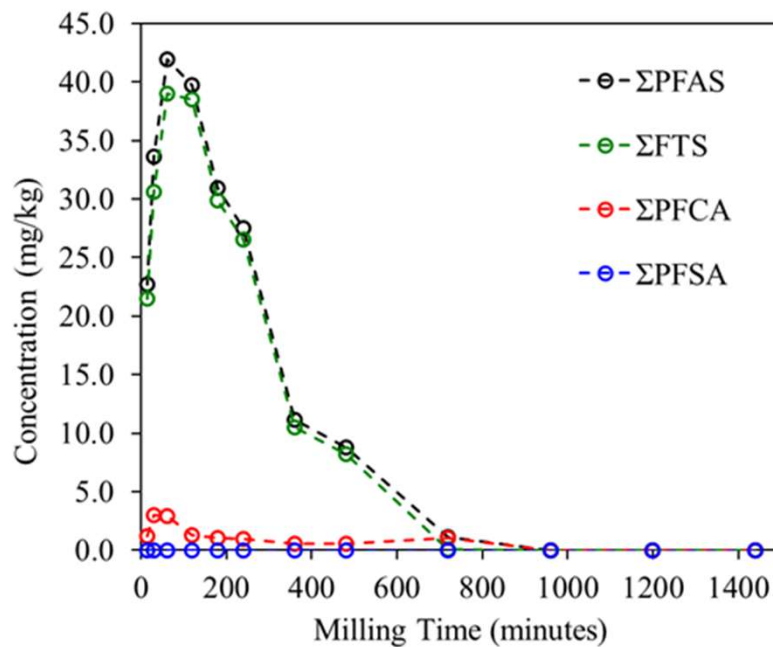
Gobindlal et al. 2021. J Phys Chem



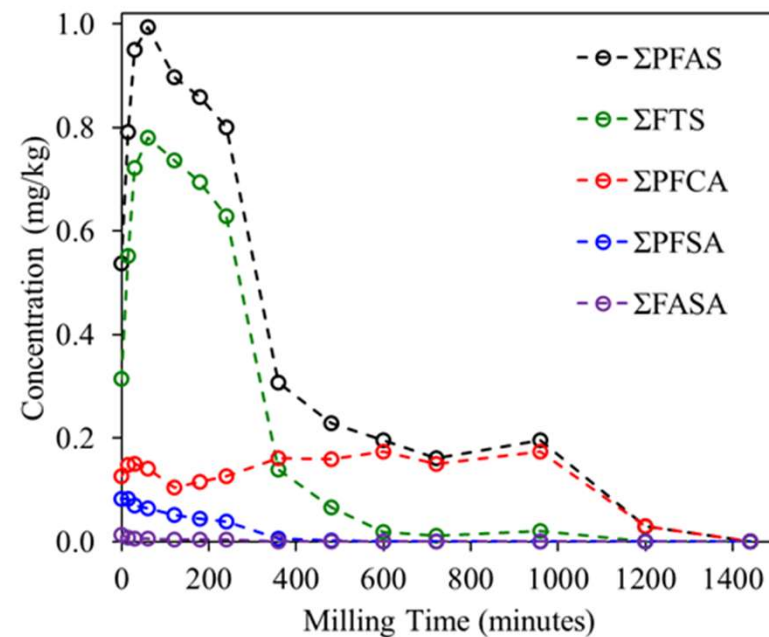
LC-MS/MS
HRMS
Solid-State NMR
CIC
EPR
FTIR
Powder XRD
XPS
BET

EDL's Bench-Scale PFAS Results to Date

Tridol S3 C6 AFFF



Legacy AFFF-Impacted Soil



Gobindlal et al. 2023. Environ Sci Adv

EDL's Pilot-Scale PFAS Projects to Date

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Evaluation of Ball Milling as a Destruction Technique for PFAS in Impacted Soil

ER24-8246

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Objective

Ball milling, also known as mechanochemical destruction (MCD), is a novel treatment method that can destroy per- and polyfluoroalkyl substances (PFAS) by exploiting the mechanical energy induced by high velocity ball-to-ball and ball-to-surface collisions within reaction vessels. The objectives of the technology validation program include establishing the scalability of MCD as an effective PFAS destruction technique for PFAS-laden solids, with a focus on impacted soil originating from firefighting training sites. Furthermore, this project will also include an in-depth feasibility study encompassing operational aspects, technology optimization at pilot-scale, and system implementation.

- R&D underway for PFAS destruction using deployable systems
- Full technical AND commercial case will be developed to determine 'product fit'
- EDL will provide a commercial engineered solution for use across DoD PFAS challenges
- Establish baseline capability to explore other PFAS-laden solids (e.g., sorbents, biosolids, concrete and asphalt)

AFCEC Pilot-Scale Demonstration

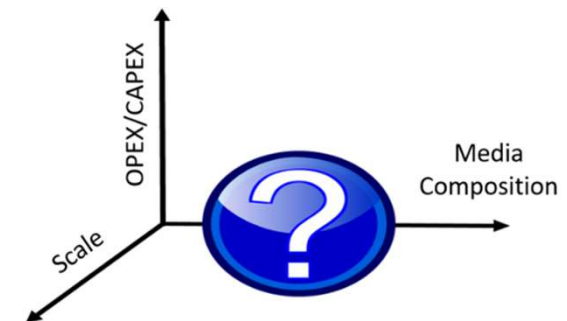
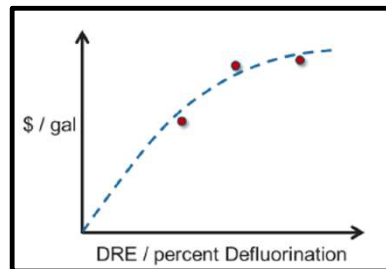
➤ **Bench-scale experiments with three PFAS-impacted media at AFCEC's discretion – e.g.:**

- Source zone soil
- Spent sorbent media
- Concrete

➤ **Pilot-scale demonstration on-site with one of the three media**

- Multiple trials to establish full cost and performance curve
- ~4 weeks of treatment

Goal: Establish Niche for PFAS Market



Full Scale Application: Scenario 1 (High Conc/Low Volume)



- Relatively small footprint
- Continuous or semi-continuous (batch with recirculation) operation
- ≤ 2 tonne/hour
- Dust mitigation – negative pressure with baghouse and VGAC for indoor applications

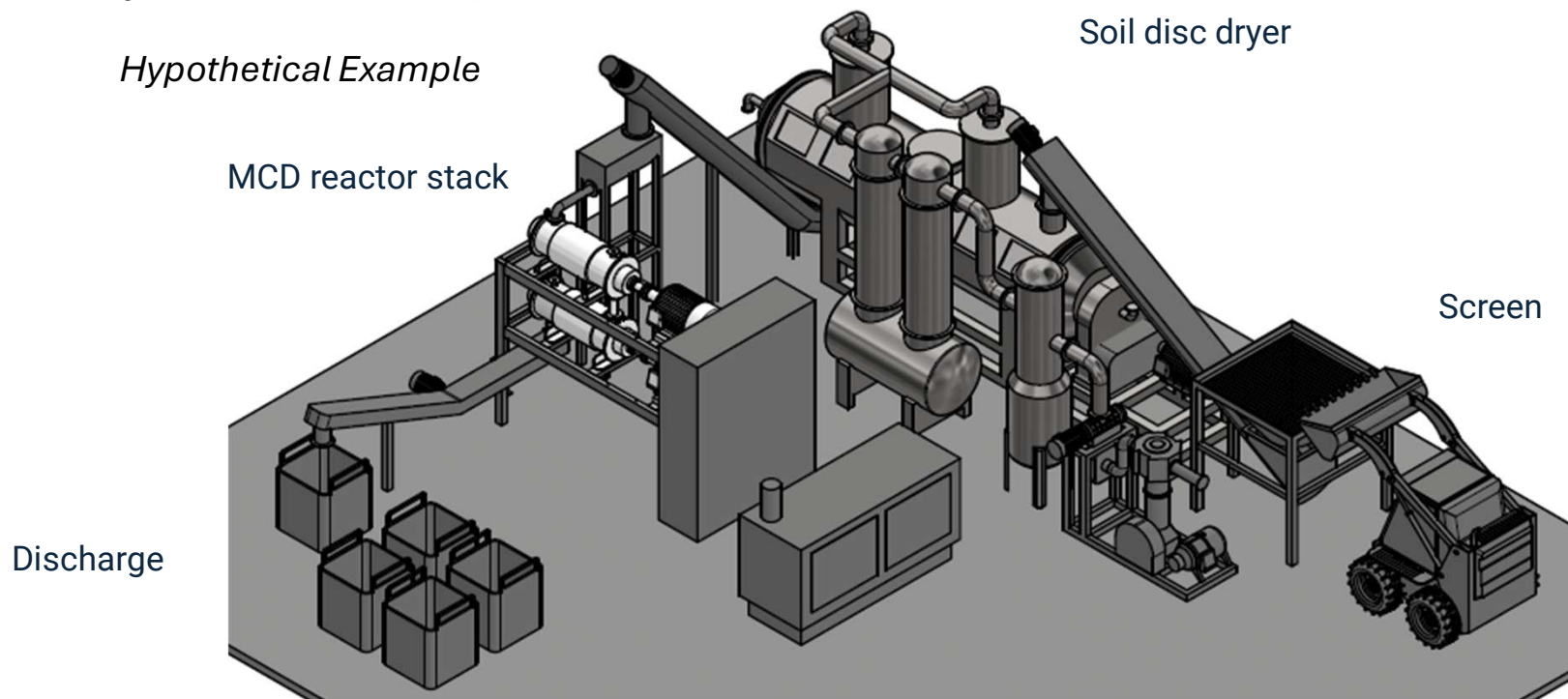
Full Scale Application: Scenario 1 (High Conc/Low Volume)



Full Scale Application: Scenario 2 (High Volume)

➤ Fully customizable design

Hypothetical Example



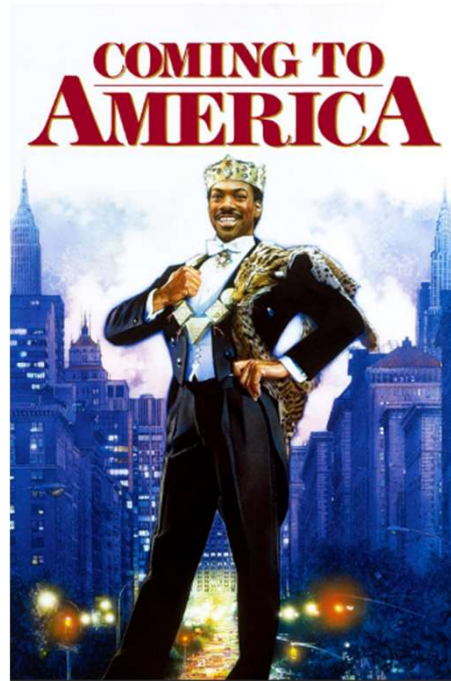
Hypothetical Full-Scale (5-10 t/h) Electrical Demand

Component	Electrical Demand (kW)
8 MCD Reactors	350
Drying System	180
Auger System	35
Pug Mill	10
Screening	5.0
Fans	3.0
Total	580

Total Demand = 58-117 kWh/t



Coming Soon.....



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Questions?



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