



Mechanochemical Destruction of PFAS

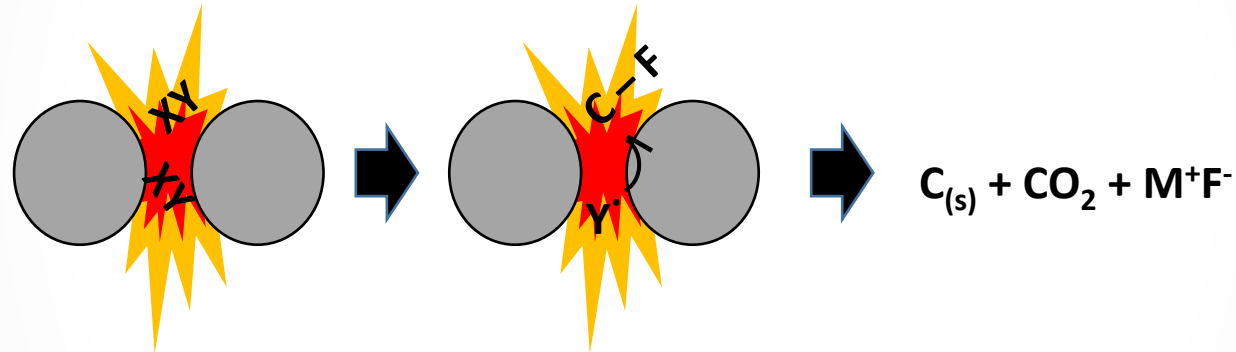
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- Mechanochemical destruction (MCD) occurs due to the localized high energy imparted by milling ball collisions^{1,2}
 - Fracturing the matrix creates a radical rich reductive environment
 - Ball-mills can scale from 10 – 25 g benchtop mills to large mills that can process ~3 tons/hour



- MCD currently used to treat persistent organic pollutant contaminated soils in the field.
- Literature shows that PFAS can be destroyed in simple matrices with benchtop ball-mills^{1,2}
- Remediation of PFAS contaminated soil is difficult
 - High energy requirements to heat soil to temperatures adequate for PFAS desorption or destruction
 - Complex matrix interactions make rinsing the soil difficult
- Can MCD be used to remediate PFAS contaminated soils and other solids at a useful scale?

1. Cagnetta, G.; et al. *Critical Reviews in Environmental Science and Technology* **2018**, 48 (7-9), 723-771.

2. Roesch, P.; et al. *Int J Environ Res Public Health* **2020**, 17 (19), 7242.

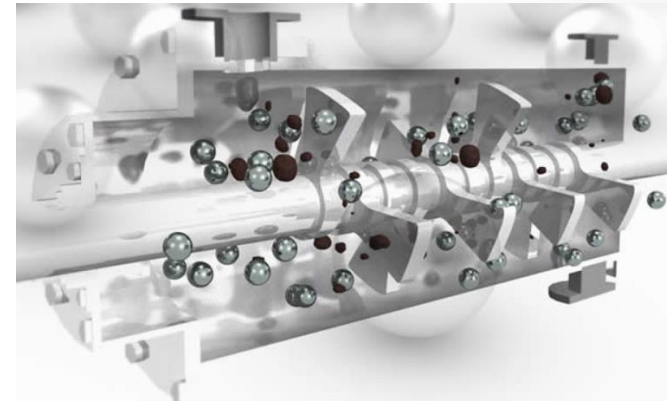
- Start treating PFAS impacted solids at lab-scale, then pilot-scale, then full-scale
 - Test contaminated soils, sorbents, solids, and reagents, like sand or potassium hydroxide
 - Determine energetics to allow effective scale up, calculations base on the kinetic energy of the impacts



Benchtop planetary ball-mill, 20 – 40 g sample



Batch pilot-scale stirred ball-mill, 100 kg batch size



Schematic of full-scale flow through stirred ball-mill, 3 ton/h capacity

- Determine fluorine's fate
 - PFAS and PFAS byproducts in solid and gas phases
 - Inorganic fluorine in solid and gas phases

- Recent literature¹ and ORD coordinated experiments show PFAS contaminated soils can be remediated using MCD
 - 20 – 25 g PFAS spiked and AFFF contaminated soil were treated with a benchtop ball-mill
 - Targeted PFAS were destroyed in the soil
 - Analysis of gaseous emissions and further nontargeted analyses are still needed
- Milling concentrated aqueous film forming foam (AFFF) and sand looks like a promising method to destroy AFFF
- In-house ORD benchtop experiments to verify results are ongoing
- ORD contractor indicated the PFAS destruction profile matches other pollutant that have been treated in their full-scale system
 - Would like to test the 100 kg batch ball-mill to ensure the process scales as predicted
 - Potential field test at 3 tons/hour treatment rate



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