

2016

Smart Medication Disposal: Subcritical Water Oxidation of Pharmaceutical Compounds

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Smart Medication Disposal

Subcritical Water Oxidation of Pharmaceutical Compounds

Introduction

You may be drinking your neighbor's medications – and not know it! Unused and expired pharmaceutical waste is growing. Smart and safe disposal methods are increasingly critical to preventing drug diversion and environmental pollution. Water analysis from 24 major metro areas in the US, researchers found:

- Potable water tested contained significant amounts of antibiotics.
- Other drugs were routinely identified, including antidepressants, stimulants and birth control medications.

Our goal: develop a prototype medication disposal unit that can efficiently and safely inactivate medicinal compounds for a target market of pharmacies, assisted-care facilities, and hospitals.

Process Design

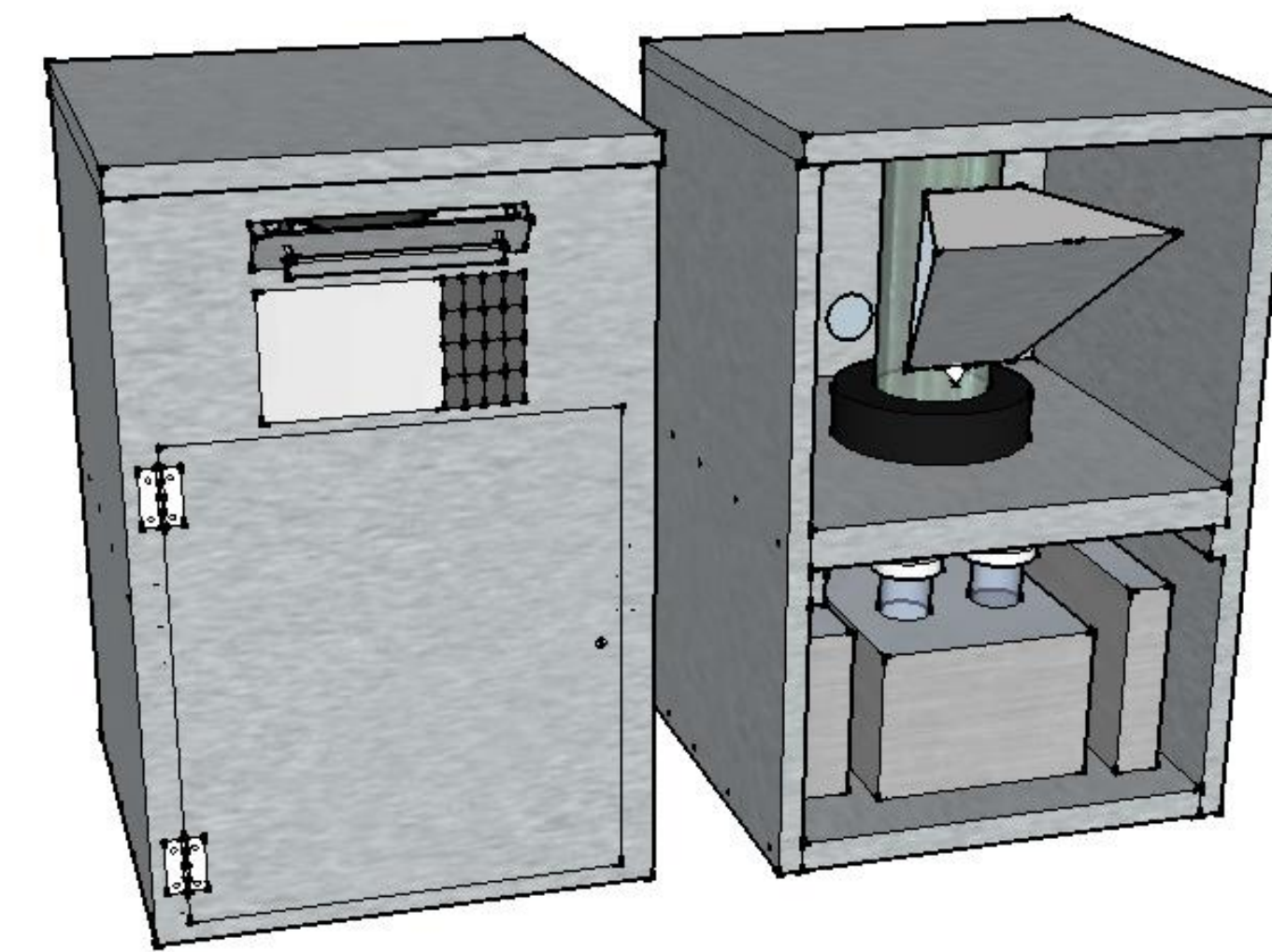


Figure 1: Unit Design

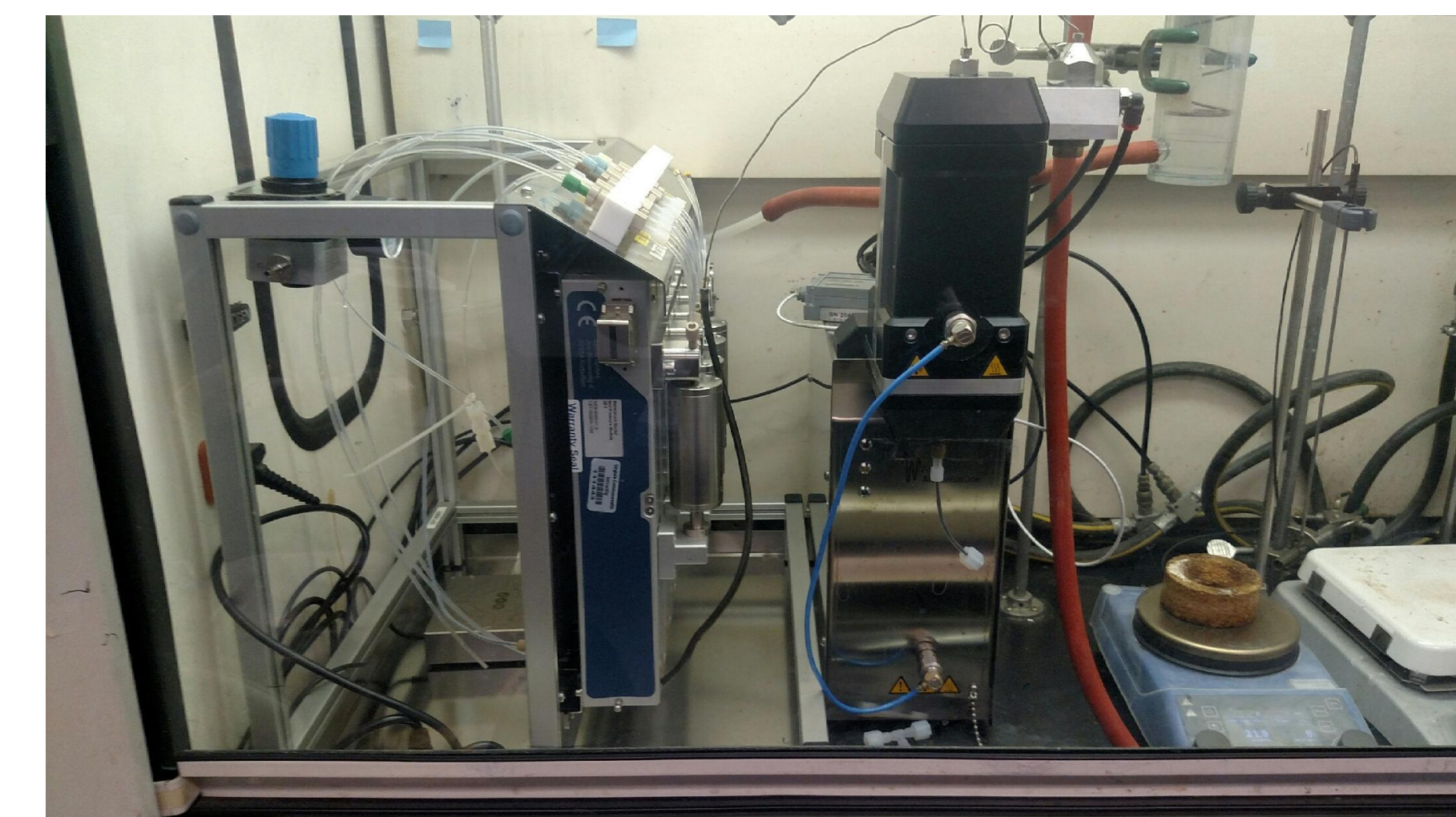


Figure 2: Microwave flow reactor

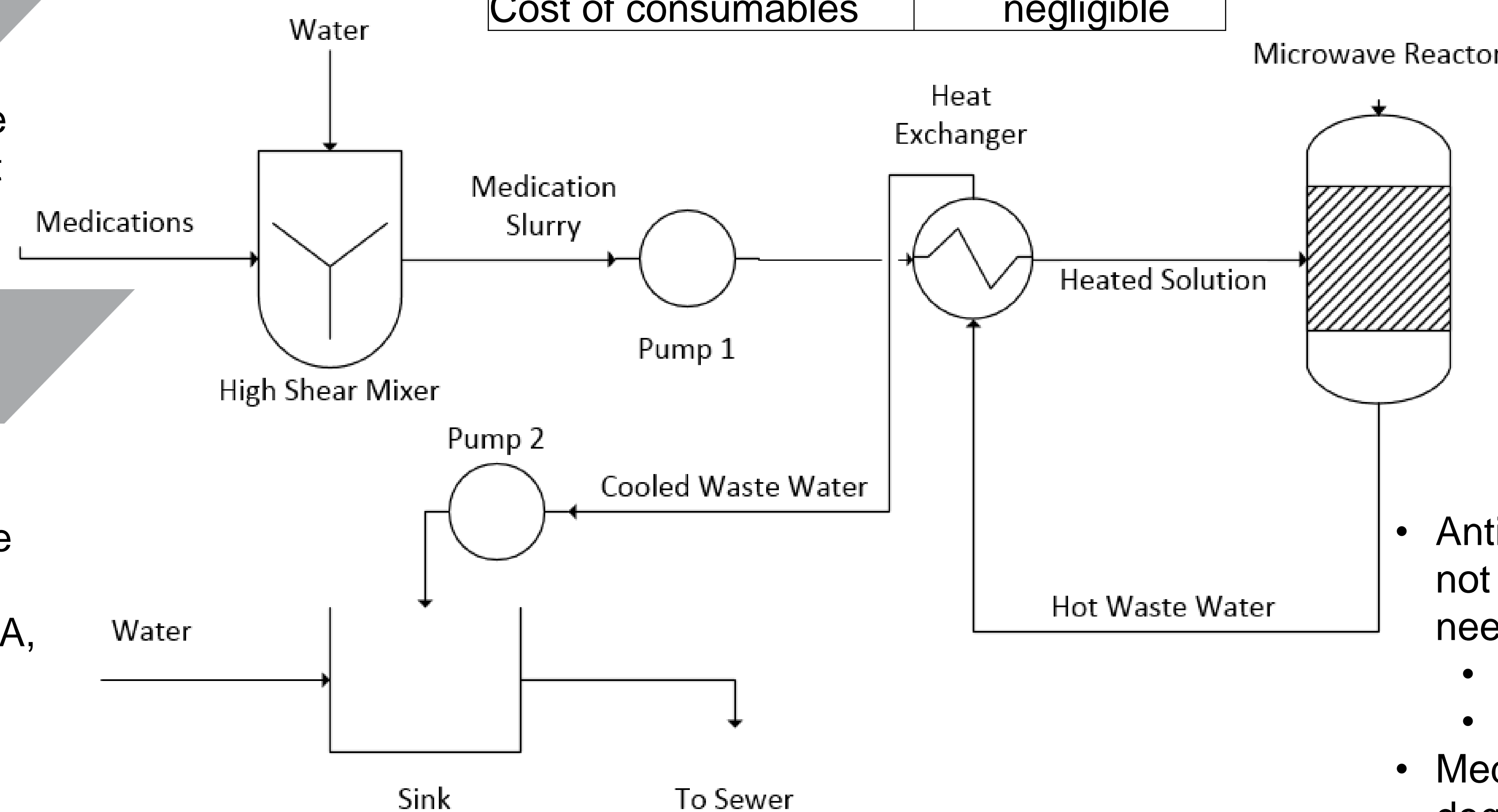
Unit Information	
Waste processed	10kg/day
Volume processed	100L/day
Cost of unit	\$ 25,000.00
Cost of consumables	negligible

Hypothesis

Microwave Assisted Subcritical Water Oxidation is able to degrade multiple medications into non-active compounds, in a process that is energy efficient, safe, and scalable.

Market Analysis

The FDA and DEA recommend disposal of medications using absorbents (e.g. kitty litter). However, target institutions either use hazardous waste contractors or practice non-recommended disposal methods. With anticipated regulatory changes within FDA, DEA and EPA, this device will provide an approved, safe, ecofriendly and cost-effective means of drug disposal.



Results

Chemical Name	Uses	Degradation
Acetaminophen	Pain reliever and fever reducer	Yes
Aspirin	Pain reliever and fever reducer	Yes
Cetirizine	Antihistamine	Yes
Phenylephrine	Decongestant and Vasodilator	Yes
Loperamide	Antidiarrheal	No
Vitamin C	Vitamin Supplement	No

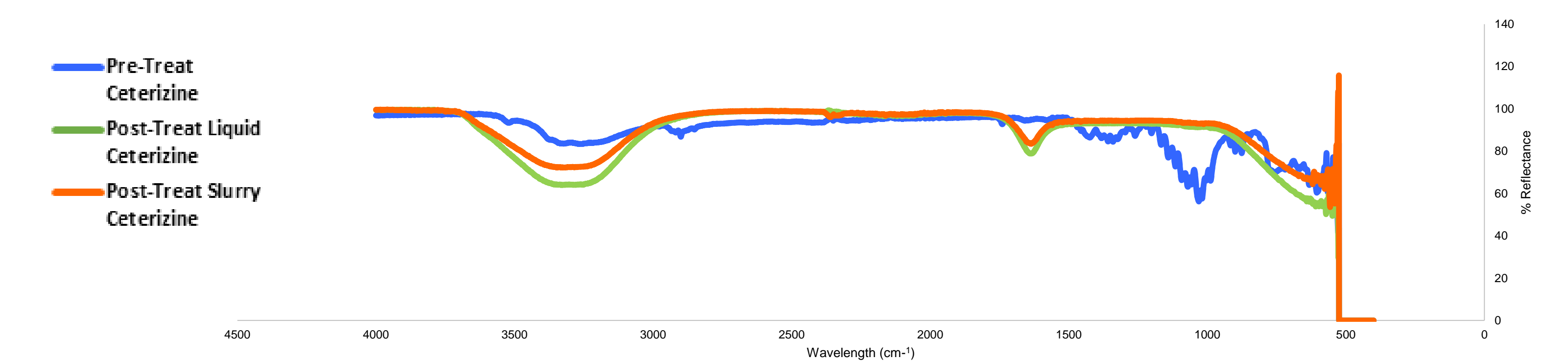


Figure 1: AT-IR spectra of the degradation of cetirizine compared to base

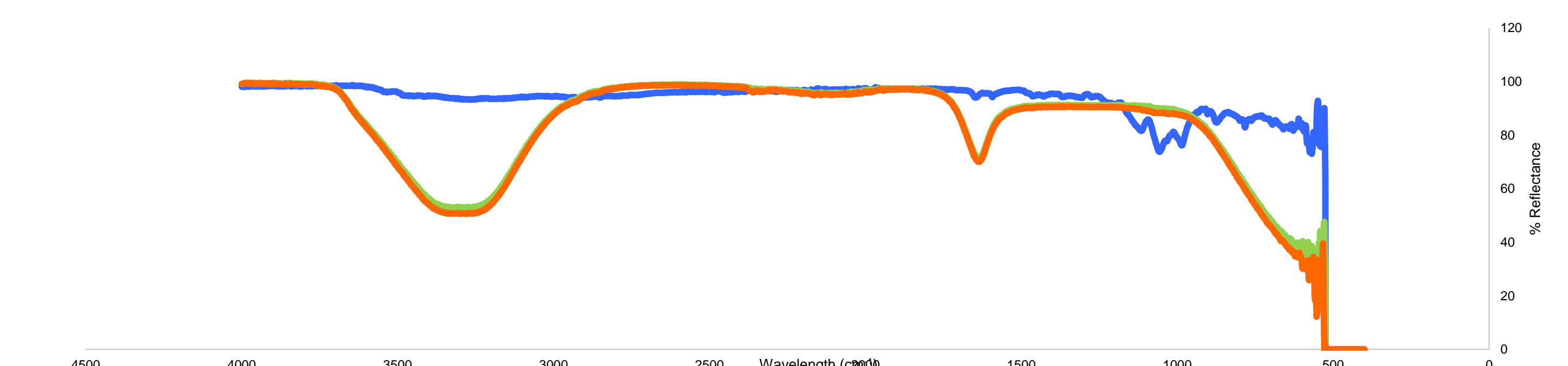


Figure 2: AT-IR spectra of degraded phenylephrine compared to original spectra

Conclusions and Next Steps

- Antioxidants and molecules which are not hydrolyzed at 200 °C and 12.5 atm were not degraded – additional testing needed to identify appropriate methods are needed.
 - Solvent testing
 - More powerful reactor
- Medications containing chlorine, phenol, amide, ether, and ester groups can be degraded.
- Unit is easy to run by a trained operator.
- Unit is able to degrade 85% of drugs using the current method.

