TABLE OF CONTENTS

	Section	Page
1.	Executive Summary	2
2.	Introduction	2
3	Materials and Equipment	2
4.	HPLC Method	3
5.	Reagent Preparation	3
6.	Experimental Notes	3
7.	Results and Discussion	4
8.	Conclusion	5
	Appendix 1 (chromatographs)	6

AUTHOR:_____
Printed Name of Author: Paul R. Johnson

REVIEWED/APPROVED BY:

_____

Mali R. Gupta, Director of PERC

1. EXECUTIVE SUMMARY

This report summarizes work performed under Work Order CREW-11012018-000. A series of 4 runs were carried out with a variety of drug products to evaluate the Rx Destruct instrument. The Rx Destruct instrument is an automated pharmaceutical degradation/destruction instrument that adds a required amount of hydrogen peroxide and ferrous sulfate in two doses to pharmaceutical solutions added to it. The drugs used to test the instrument were Class II opioid controlled substances (fentanyl citrate, morphine hydrochloride, hydromorphone hydrochloride) and propofol. An HPLC assay was performed before and after the treatment of the drugs with the Rx Destruct instrument. The Rx Destruct instrument treatment of the drugs showed no detectable drug in the effluent of the instrument.

2. INTRODUCTION

Campbell University Pharmaceutical Education & Research Center was contracted by Clear River Enviro, LLC to evaluate the Rx Destruct instrument and perform a series of tests to evaluate the operation and effectiveness of the Rx Destruct.

3. MATERIALS AND EQUIPMENT

The following materials were used:

- Acetonitrile (ACN)
- Deionized Water
- Trifluoroacetic Acid (TFA)
- 30% Hydrogen Peroxide
- Ferrous Sulfate Heptahydrate
- Fentanyl 10 mcg/mL (as Fentanyl citrate); 250 mL IV bags
- Morphine HCl 50 mg/mL (20 mL) vial
- Hydromophone HCl 2 mg/mL syringes
- Propofol (Diprivan) emulsion USP 500 mg/50 mL (10 mg/mL)

The following equipment was used:

- Agilent 1100 HPLC with Diode Array Detector and Chemstation Software
- Phenomenex Luna C18(2) 50 mm x 3 mm 3µ HPLC column
- VWR Syringe filters, 0.45µ , 25mm, polypropylene membrane
- Rx Destruct Instrument 

4. HPLC METHOD

The HPLC method used is shown below that successfully separated the four drugs with sufficient resolution to quantify each drug.

Mobile Phase A	Water with 0.05% TFA
Mobile Phase B	ACN with 0.05% TFA
Gradient	0%B to 95%B in 8 minutes
Flow Rate	1 mL per minute
Column	Luna C18(2) 50x3.0mm 3µ at 40°C
Injection volume	5 µL
Detection	220 nm
Total Run Time	10 minutes

5. REAGENT PREPARATION

5.1 Preparation of Ferrous Sulfate Reagent (1M)

Ferrous Sulfate Heptahydrate 139 g was weighed and placed into a 500 mL volumetric flask. DI water was degassed by running it through a 0.45 micron filter under vacuum. The degassed water was added to the 500 mL mark of the flask and the solution swirled to complete solution. This solution was labeled as Iron reagent 1 M. The solution (180 mL) was loaded into an IV bag using a 60 mL syringe taking care to exclude all air from the bag, and placed into the instrument.

5.2 Hydrogen Peroxide

The 30% hydrogen peroxide was used directly in a bottle in the instrument.

6. EXPERIMENTAL NOTES –ON SITE EVALUATION OF RX DESTRUCT INSTRUMENT

The Hydrogen Peroxide and Ferrous Sulfate solutions were added to the instrument and the lines primed with the priming function. Prior to the start of each run, a sample of the drug solution was collected and placed in a vial labeled pre-run #. At the end each run the effluent was collected and analyzed by HPLC along with the sample taken prior to the run. The pre-run samples were diluted by a factor of 3 to equal the dilution of the sample in the instrument. The samples from the post run effluent were filtered through a syringe filter and run at the delivered concentration.

The instrument's programmed reaction function triggers when the fill sensor signals a full input reservoir. This occurs when 350 mL is added to the top input reservoir of the instrument. Immediately when the instruments fill sensor triggers the start of the run cycle, the 650 mL of water in the holding tank along with the 350 mL of the drug solution is delivered to the reaction tank. The Ferrous Sulfate and Hydrogen Peroxide, 5 mL each, are added vial peristaltic pumps and the solution

in the reaction tank is circulated with a centrifugal pump. After 8 minutes a second 5 mL delivery of each of the 2 reagents is added and circulated for another 8 minutes. The reaction tank is then evacuated to the effluent tube. This was collected into a 2 liter Erlenmeyer flask for sampling and analysis.

6.1 Run 1

Fentanyl (10 mcg/mL) 350 mL taken from the IV bags, measured with a graduated cylinder and added to the instrument. After the reaction run the instrument evacuated the reaction tank through the effluent tube, which was collected for analysis as described above.

6.2 Run 2

Fentanyl (10 mcg/mL) 350 mL taken from the IV bags and measured with a graduated cylinder. An additional 5 mL of Ferrous Sulfate solution was added to test if more Iron (II) would improve the reaction completion. The solution was added to the instrument. After the reaction run the instrument evacuated the reaction tank through the effluent tube, which was collected for analysis as described above.

6.3 Run 3

Morphine HCl (50 mg/mL) 20 mL and Hydromorphone HCl (2 mg/mL) 5 mL were added to a graduated cylinder and diluted to 350 mL with water. The solution was added to the instrument. After the reaction run the instrument evacuated the reaction tank through the effluent tube, which was collected for analysis as described above.

6.4 Run 4

Propofol (500 mg/50 mL, Diprivan USP) is an emulsion containing soybean oil (100 mg/mL), glycerol (22.5 mg/mL), egg lecithin (12 mg/mL). The propofol emulsion (10 mg/mL) 50 mL was added to a graduated cylinder and diluted to 350 mL with water. The mixture was added to the instrument. After the reaction run the instrument evacuated the reaction tank through the effluent tube, which was collected for analysis as described above.

7. RESULTS and DISCUSSION

7.1 Run 1

Fentanyl is seen at retention time 3.7 min. in the pre-run #1 chromatograph. The chromatograph of the effluent collected showed no detectable Fentanyl. See chromatographs in the appendix.

7.2 Run 2

Fentanyl is seen at retention time 3.7 min. in the pre-run #2 chromatograph. The chromatograph of the effluent collected showed no detectable Fentanyl. The addition of additional ferrous sulfate had no additional benefit. See chromatographs in the appendix.

7.3 Run 3

Morphine HCl (1000 mg) and hydromorphone HCl (10 mg) can be seen at retention times 2.0 min. and 4.0 min. respectively in the pre-run #3 chromatograph. The chromatograph of the effluent collected showed no detectable morphine and no detectable hydromorphone. See chromatographs in the appendix

7.4 Run 4

Propofol is seen at retention time 6.07 min. in the pre-run #4 chromatograph. The chromatograph of the effluent collected showed no detectable propofol. See chromatographs in the appendix.

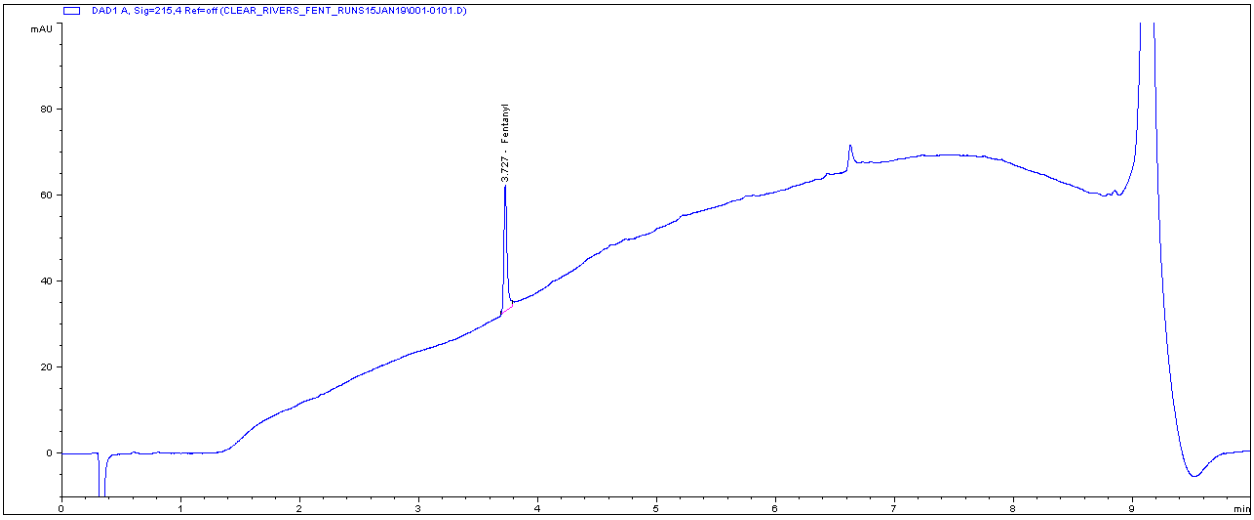
8. CONCLUSION

The Rx Destruct preformed in the intended automated fashion. The degradation of drugs resulted in undetectable concentrations of drugs. We did not determine the limit of detection or limit of quantitation for these drugs.

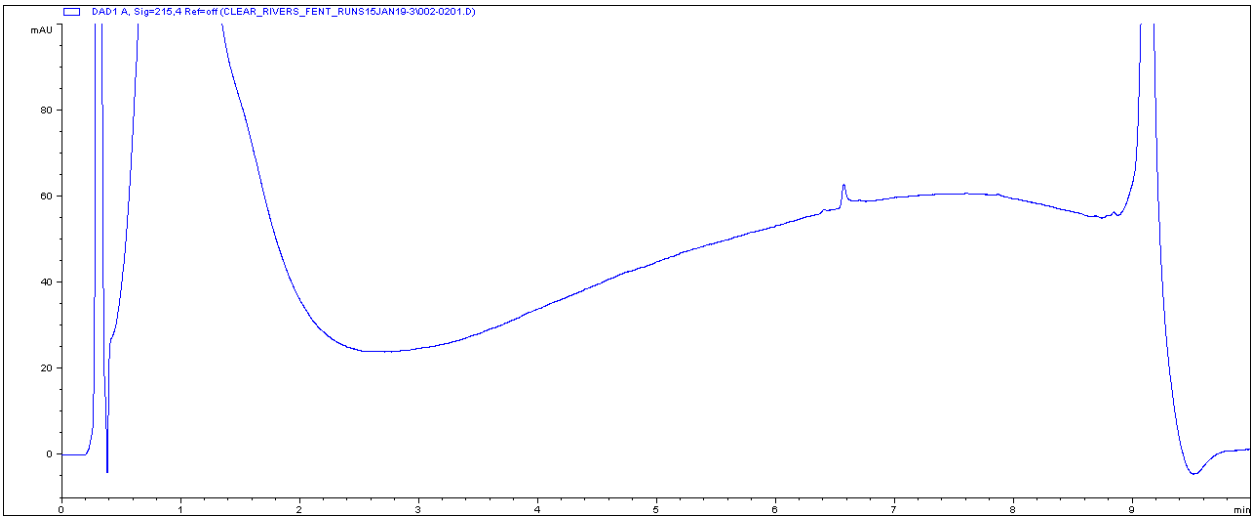
Appendix 1: Chromatographs

Note that all the pre run samples were diluted by a factor of three to match the dilution from the Rx Destruct instrument.

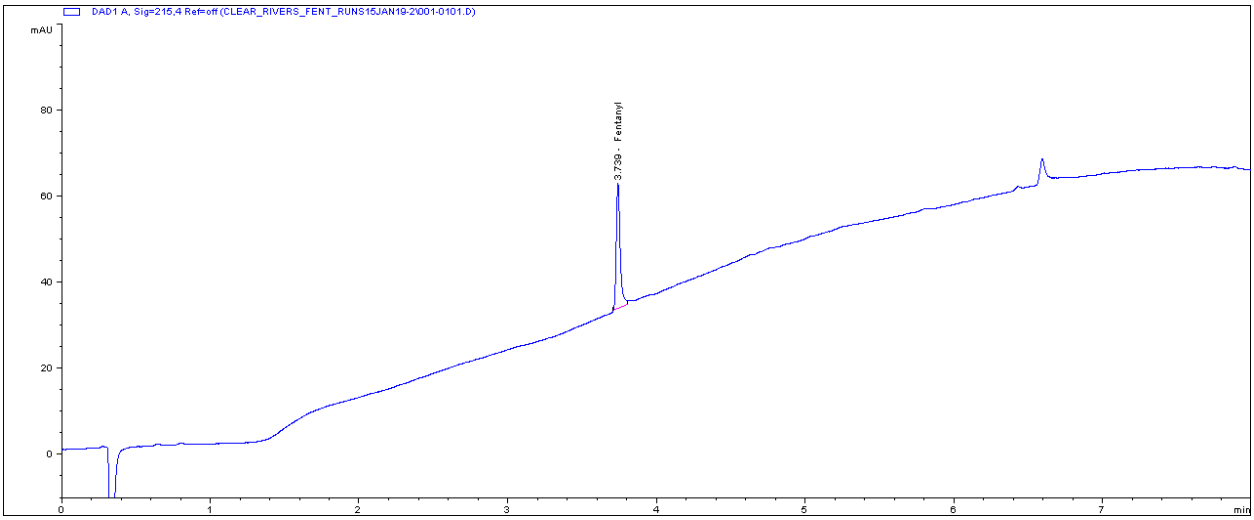
Pre-run #1



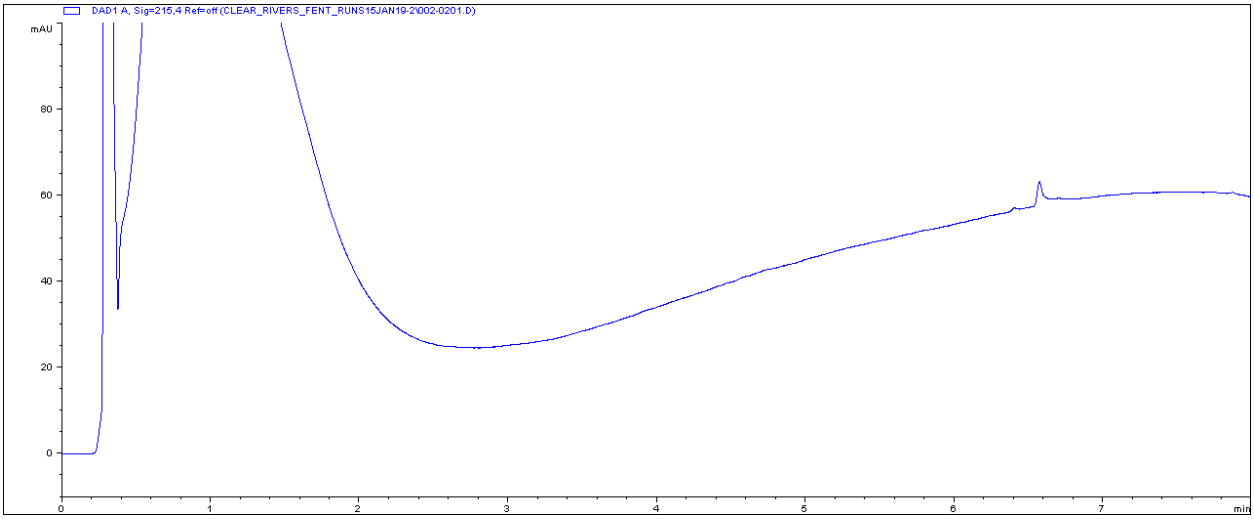
Post-run #1



Pre-Run #2



Post-Run #2



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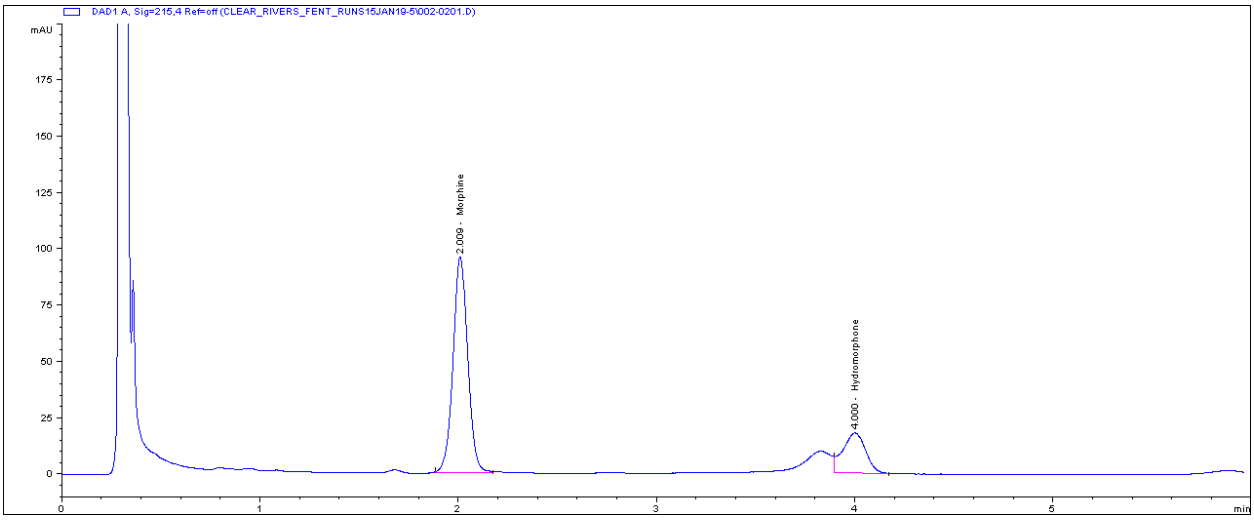
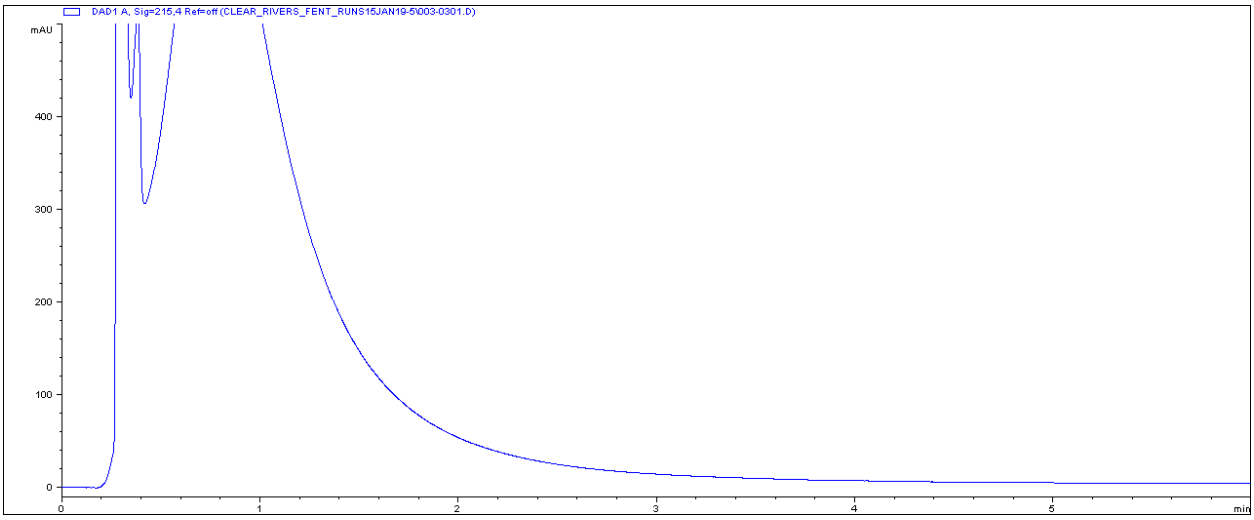
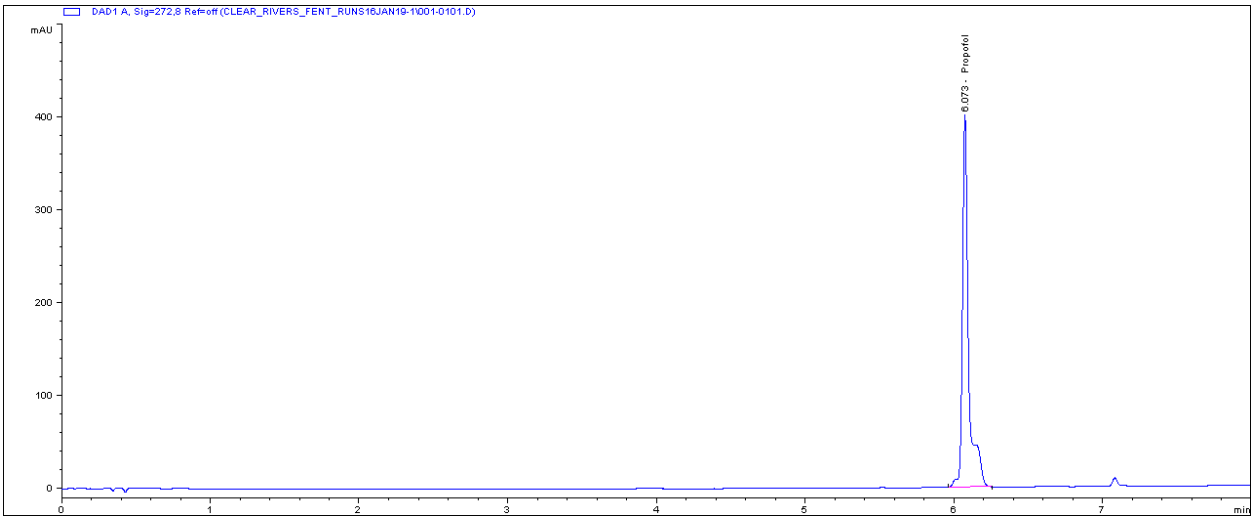


Post-run #3



Pre-run #4



Post-run #4