

**ADSORPTION-DESORPTION BEHAVIOUR AND MECHANISMS OF  
PYRIMETHAMINE AND METRONIDAZOLE BENZOATE ON POLYSTYRENE,  
POLYETHYLENE AND POLYETHYLENE TEREPHTHALATE MICROPLASTICS**

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**SEPTEMBER, 2021**

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**A DISSERTATION SUBMITTED TO THE SCHOOL OF POST GRADUATE  
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CHEMISTRY IN THE DEPARTMENT OF CHEMISTRY, COLLEGE OF SCIENCE  
AND TECHNOLOGY, COVENANT UNIVERSITY.**

**SEPTEMBER, 2021**

## ACCEPTANCE

This is to attest that this dissertation is accepted in partial fulfilment of the requirements for the award of the Degree of Master of Sciences in Industrial Chemistry in the Department of Chemistry, College of Science, Covenant University, Ota, Nigeria.

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## **DECLARATION**

I, **AGBOOLA, OMOWUMI DARLINGTON (19PCC01975)** declares that this research was carried out by me under the supervision of Prof. Nsikak U. Benson of the Department of Industrial Chemistry, College of Science and Technology, Covenant University, Ota, Nigeria. I attest that the dissertation has not been presented either wholly or partially for the award of any degree elsewhere. All sources of data and scholarly information used in this dissertation are duly acknowledged.

**AGBOOLA, OMOWUMI DARLINGTON**

.....  
**Signature and Date**

## CERTIFICATION

We certify that this dissertation titled “**ADSORPTION-DESORPTION BEHAVIOUR AND MECHANISMS OF PYRIMETHAMINE AND METRONIDAZOLE BENZOATE ON POLYSTYRENE, POLYETHYLENE AND POLYETHYLENE TEREPHTHALATE MICROPLASTICS**” is an original research work carried out by **AGBOOLA, OMOWUMI DARLINGTON (19PCC01975)** in the Department of Industrial Chemistry, College of Science and Technology, Covenant University, Ota, Ogun State, Nigeria under the supervision of Prof. Nsikak U. Benson. We have examined and found this work acceptable as part of the requirements for the award of Master of Science in Industrial Chemistry.

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## **DEDICATION**

To God Almighty, the one who has been good and will always be.

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## LIST OF ABBREVIATIONS

|                  |                                                                           |
|------------------|---------------------------------------------------------------------------|
| 4-MBC            | 4-Methyl benzylidene camphor                                              |
| 5-FU             | 5- Fluorouracil                                                           |
| AMX              | Amoxicillin                                                               |
| ATR-FTIR         | Attenuated Total Reflectance Fourier-Transform Infrared Spectrophotometer |
| CBZ              | Carbamazepine                                                             |
| CEP-C            | Cephalosporin C                                                           |
| CIP              | Ciprofloxacin                                                             |
| DOM              | Dissolved organic matter                                                  |
| EE2              | 17 $\alpha$ -Ethinyl estradiol                                            |
| ENR              | Enrofloxacin                                                              |
| FEN              | Fenbendazole                                                              |
| FLU              | Flubendazole                                                              |
| HDPE             | High density polyethylene                                                 |
| HNO <sub>3</sub> | Nitric acid                                                               |
| HPLC/MS          | High-performance liquid chromatography-mass spectrometer                  |
| LDPE             | Low density polyethylene                                                  |
| MET              | Methotrexate                                                              |
| MNZ              | Metronidazole                                                             |
| NaOH             | Sodium hydroxide                                                          |
| NOD              | Nadolol                                                                   |
| NOR              | Norfloxacin                                                               |
| PA               | Polyamide                                                                 |
| PA               | Polymers polyamide                                                        |
| PE               | Polyethylene                                                              |
| PLA              | Polylactic acid                                                           |
| PP               | Polypropylene                                                             |
| PPCPs            | Pharmaceuticals and Personal Care Products                                |
| PRO              | Propranolol                                                               |
| PS               | Polystyrene                                                               |

|     |                            |
|-----|----------------------------|
| PVC | Polyvinyl chloride         |
| PYM | Pyrimethamine              |
| SDZ | Sulfadiazine               |
| SMT | Sulfamethazine             |
| SMX | Sulfamethoxazole           |
| TC  | Tetracycline               |
| TCS | Triclosan                  |
| TH  | Tetracycline hydrochloride |
| TMP | Trimethoprim               |

## ABSTRACT

Research studies over the years have shown the presence of contaminated plastic debris in the organs of marine organisms. In addition to the problems presented by improper disposal of plastics giving rise to presence of microplastics in the environment, is the sorption of pharmaceuticals on plastic polymers and their persistence which contributes to their long-range transport into the marine environment. Numerous studies have been done to investigate adsorption of different types of antibiotics. However, very little has been done on antimalarial drugs commonly used to treat prevalent malarial disease in Nigeria. This research work aims to investigate the adsorption behaviour of pyrimethamine and metronidazole benzoate on 3 types of plastic polymers which include polystyrene, polyethylene, and polyethylene terephthalate through batch adsorption experiment. Contributing factors like pH, concentration of drug standards, and contact time, were varied to study points of optimal sorption. The pH of aquatic media was varied between 4 and 8 using NaOH and HCl, initial concentration was varied between 20 mg/L and 100 mg/L, while contact time was varied between 0hour and 48hours. The identity of the plastic polymers was confirmed using an FTIR, while HPLC was used to confirm the concentration of the analytes before and after adsorption. Results showed that adsorption increased from 20% to 69% with increase in initial concentration between 20 mg/L and 100 mg/L, adsorption isotherm showed that adsorption best fit into the Langmuir adsorption with a correlation coefficient ( $R^2$ ) of 0.9938, pyrimethamine drug standards led to a slight increase in pH of aquatic media, however, metronidazole benzoate slightly increased pH between 4.0 to 6.0, but led to a reduction in pH of 7.0 down to 6.5 and pH of 8.0 to 7.5 was observed for metronidazole benzoate owing to the pH of MNZ being 4.3. The observed change in pH introduced by pyrimethamine and metronidazole benzoate shows that aquatic life can be influenced adversely on exposure to these drugs.

Keywords: Adsorption, microplastics, pharmaceuticals, environment.