The Catalytic Thermo-oxidative Decomposition of Glimepiride

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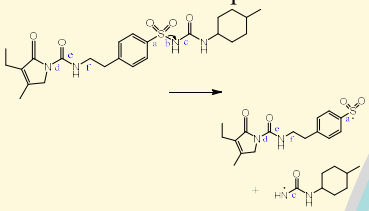
ABSTRACT

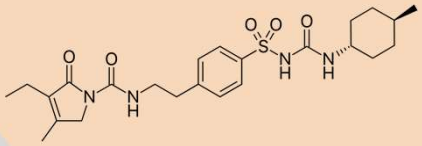
In this study, the thermal decomposition of glimepiride is analysed in the presence of N_2 and O_2 and the presence of various metal oxide catalysts. The analysis was conducted using TGA. From the results obtained, in the presence of N_2 there were two significant mass losses while an additional mass loss was observed in the presence of oxygen. The mechanism for decomposition is also proposed. Vanadium oxide was the most efficient at lowering the temperature required for thermal decomposition. The results of this study pave way for future work into purifying wastewater from pharmaceuticals via adsorption.



First step proposed for the decomposition of Glimepiride under N_2 which accounts for the first significant mass loss

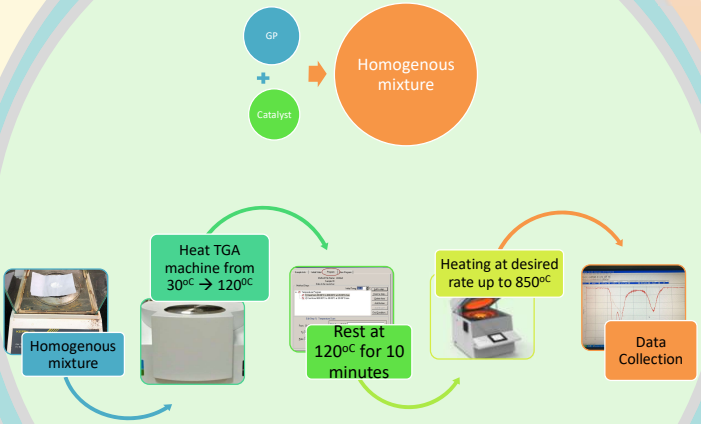
THE CONCEPT

Pharmaceutical and Personal Care Products (PPCPs) in wastewater are one of the most significant causes for concern regarding health. Wastewater treatment plants (WWTPs) fail to purify the water in a sufficient manner, thus there is a pressing need for an effective mechanism to metabolise the PPCPs present in wastewater. Glimepiride (Amaryl) is commonly used to treat type 2 diabetes. It is not completely metabolized by the human body and is thus found in wastewater. This drug is proven to be harmful to marine and aquatic life as well.

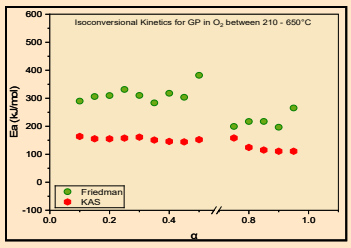


Structure of Glimepiride

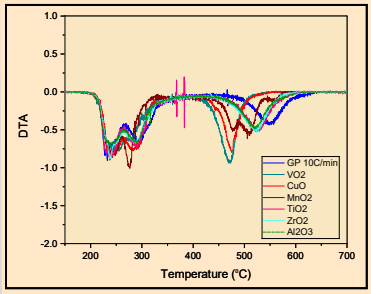
METHODOLOGY



RESULTS



Isoconversional Kinetics Analysis (Friedman and KAS) for thermal decomposition of glimepiride in O_2 between 210-650°C.



DTA curve for thermal decomposition of glimepiride in the presence of various catalysts in O2.

The results show:

- The activation energy for the first significant mass loss, which is also shown in the middle, is calculated to be approximately 170kJ/mol
- The activation energy for the decomposition under O_2 is higher as compared to N_2.
- The catalysts significantly lowered the activation energy for decomposition under O_2, as per the DTA graph, VO_2 has the most effective catalytic performance.

CONCLUSION

Under N_2 there are two significant mass loss steps and under O_2 a third one is added for the oxidation step of the drug. Using theoretical calculations, the bond energies for the decomposition mechanism were determined, which were in line with the experimental values. The results of this study are important for future work of removing glimepiride from polluted water. The findings can also be used to determine how the decomposition products can be used for useful industrial materials.

BENEFITS TO QATAR

Qatar has a significant amount of wastewater which is recycled after purification for multiple everyday uses, thus the findings of this study provide insight into how the pollutants present in wastewater can be decomposed in a manner which will result in efficient purification.

Wastewater Treatment Plant in Qatar

REFERENCES

- Badran, Ismail, et al. Thermochimica Acta 694 (2020): 178797.
- Badran, Ismail, et al. Environmental Science and Pollution Research 28.12 (2021): 14694-14706.

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