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Development of an anti-fingerprint coating for melamine laminated particleboard surfaces

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Introduction

The wide use of melamine-laminated particleboard in furniture and interior design is motivated by its affordability and aesthetic appeal. Conversely, its surface is highly susceptible to fingerprint marks caused by oils and sweat, which significantly reduces its visual quality, increases cleaning efforts, and reduces durability, resulting in a short lifespan, especially in areas of high traffic like hospitals, kitchens, and public spaces.

While chemical treatments have been applied to mitigate fingerprint visibility, these methods have limited long-term effectiveness. Thus, there's an urgent need for a highly efficient anti-fingerprint coatings

Objective

The overall objective of this work is to develop an anti-fingerprint coating for melamine-laminated particleboard surfaces via chemical modification. Our approach will improve surface liquid repellency, and we will characterize the wettability, chemical resistance and durability .

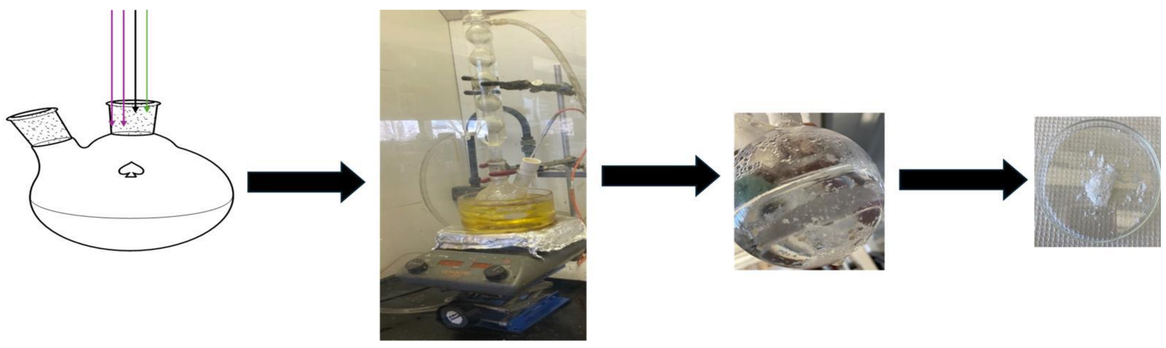
Methodology

Materials and Methods:

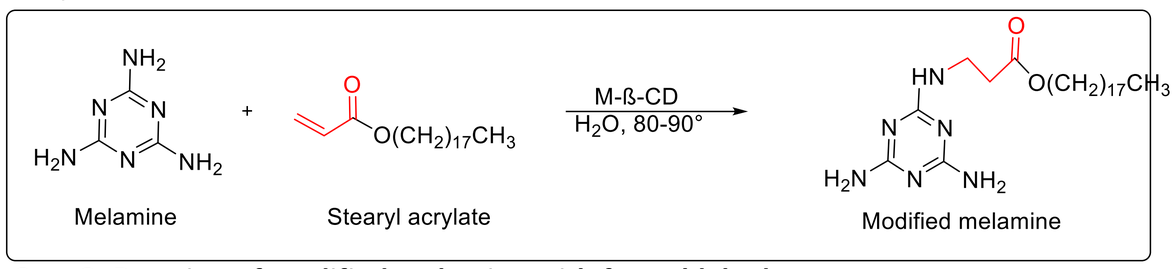
Solvent: Water

- Stearyl acrylate
- Melamine
- Methyl-beta-cyclodextrin
- Triethanolamine

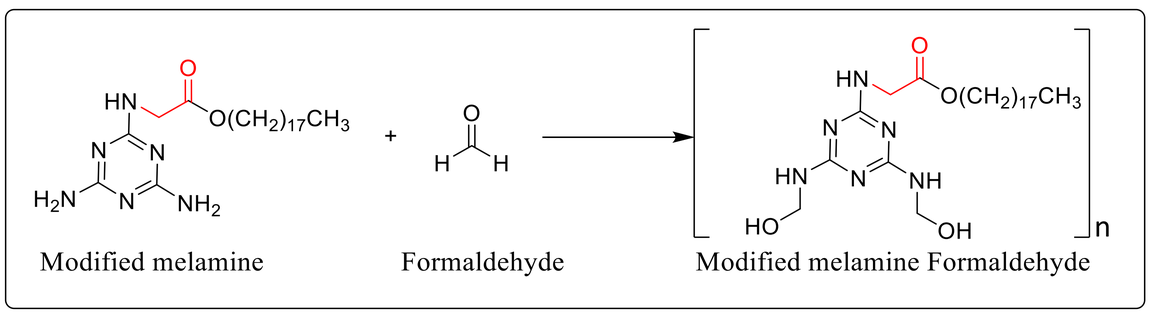
Melamine Modification by aza-Michael Addition Reaction



Step 1: Modification of melamine



Step 2: Reaction of modified melamine with formaldehyde



Next Steps

- Carry out the second step of the reaction
- Spectroscopic analysis (FTIR, ^{1}H NMR)
- Thermogravimetric Analysis (TGA)

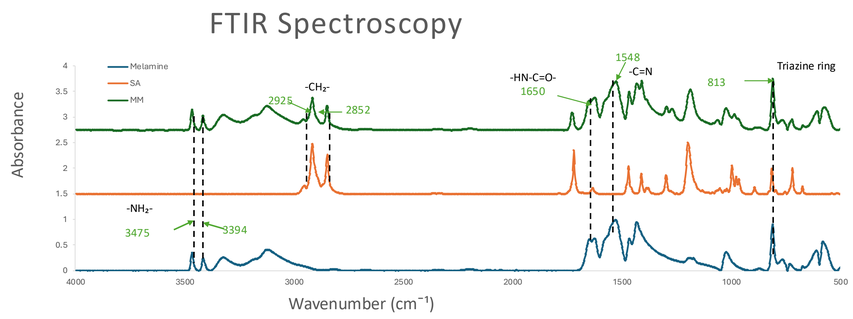
➢ The following test will be carried out on the surfaces coated with our formulation

- Contact angle measurement, Anti-fingerprint tests evaluation
- Mechanical resistance tests (scratch), Chemical resistance analysis
- Surface topography (AFM, SEM), Surface roughness

References

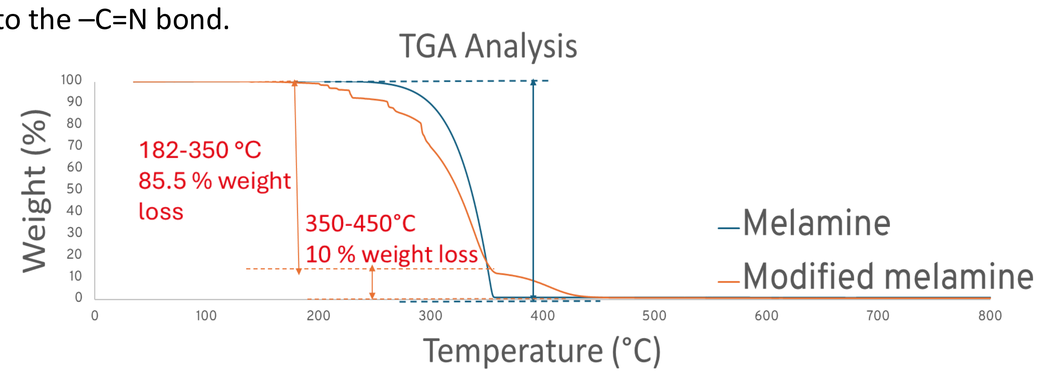
1. Wang, Cao et al. Highly transparent hydrophobic, hard and flexible coatings based on a novel melamine-formaldehyde resin synthesized by hydrophobic melamine. Progress in Organic Chemistry, 2023.
2. Kang, Shi et al. Facile fabrication of superhydrophonic porous materials using the water-based aza Michael reaction for high efficiency oil-water separation. J. sepeartion & purification techno,2023

Results



SA: Stearyl acrylate
MM: Modified melamine

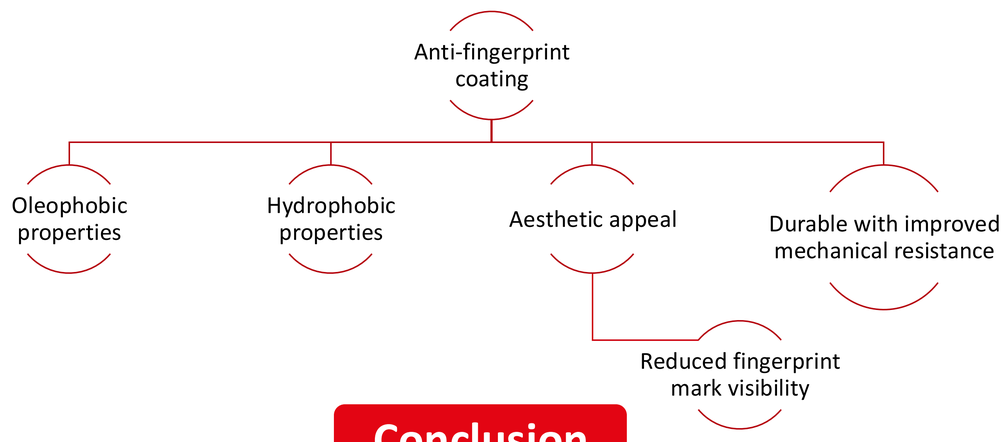
- The peaks at 3394 cm^{-1} and 3475 cm^{-1} are assigned to the N-H bond of the primary amine.
- The C-H bond peaks appeared at 2925 and 2852 cm^{-1}.
- The peak at 1650 cm^{-1} were assigned to the –HN-C=O.
- The triazine ring peak appeared at 813 cm^{-1} and the peak at 1548 cm^{-1} was assigned to the –C=N bond.



The thermal stability of melamine and modified melamine were evaluated under N_2 condition at a rate of 10 °C/min at a temperature of 35-800 °C.

- A sharp weight loss between 260-365 °C was observed for melamine and it was a one step degradation with little residue. This significant weight loss is due to the decomposition of the triazine ring.
- The TGA for the modified melamine showed multiple decomposition steps

Expected Final Results and Impacts



Conclusion

Successful modification of melamine confirmed by:

- The presence of some characteristic peaks of the reacting agents (stearyl acrylate and melamine) confirm that the modification of melamine was successful.
- The TGA results demonstrate that melamine has a higher thermal stability than the modified melamine and the decomposition of modified melamine occurs in multiple steps while melamine decomposition occurs in a single step.

Perspective

- Improved surface performance through the above modifications to enhanced self-cleaning properties, reducing cleaning time.
- Knowledge gained from this research could serve as a base for further research in coatings incorporating nanostructure for fingerprint mark invisibility.

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