



# Increasing Cold Tack of Polymeric Diphenylmethane Diisocyanate (MDI) resin with Partial Soy Flour Substitution



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## Background

Tack is defined as the adhesive failure energy of adhesive joints formed with low contact pressure during a short contact time. MDI has high moisture tolerance, short hot pressing time, low curing temperature requirement and excellent bond strength. MDI does not emit formaldehyde, a known carcinogen. However, MDI is expensive, penetrates deep into wood, drying the bondline. This results in less tack. Hence, MDI is not used in applications like particleboard production requiring high tack. Soy is cheap (costs a third of MDI), have excellent tack and poly functional groups which can crosslink with MDI. There is no specific ASTM standard for liquid based wood adhesive tack measurements.

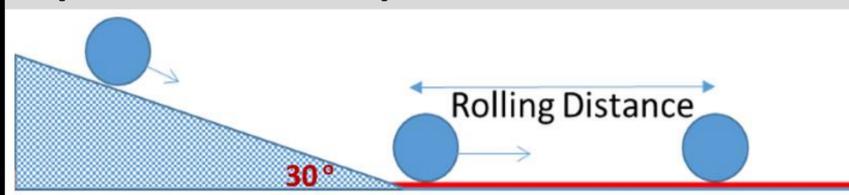
## OBJECTIVES

- To amend and characterize the cold tack of MDI with defatted soy flour.
- To assess the performance of MDI amended with soy flour in particleboard production.

## METHODS

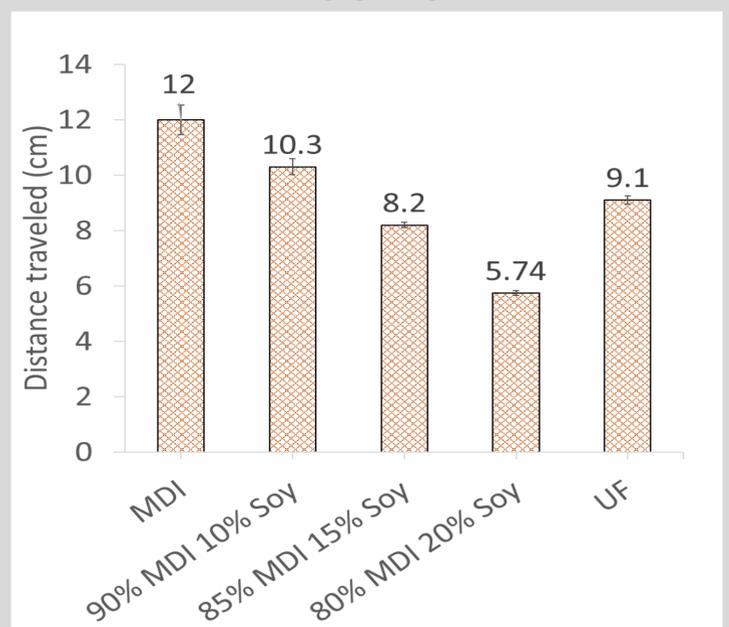
Modified ASTM D3121 (ASTM 2017) for tack measurement using resin coated metal coupons and hollow cylindrical ball. Urea formaldehyde (UF) was used as control resin.

### Experimental set up for Tack measurement



- The shorter the distance traveled by the ball on the adhesive coated metal coupons, the higher the tack.

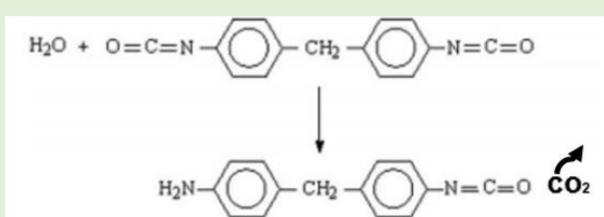
## RESULTS



Effect of soy flour substitution of MDI on distance down an inclined surface.

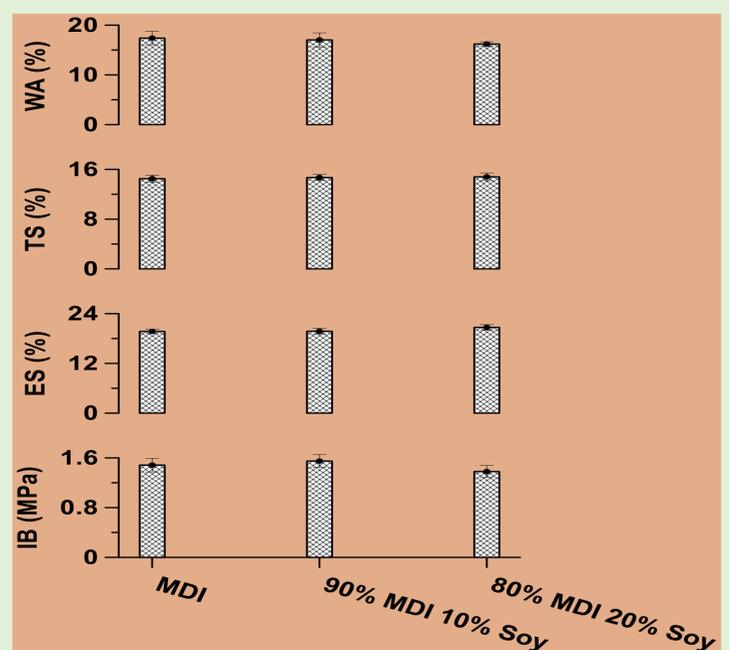
## MDI Tack Application in Particleboard

- The moisture content of the soy was 5%.
- For uniform mixture, MDI was heated to 40 °C before the soy flour was mixed.
- ASTM D1037-12 (2012) was used for the particleboard testing.
- It was found that the isocyanate reacts with water and other functional groups (OH and C=O of soy) to give off CO<sub>2</sub>



Isocyanate reaction with water

## RESULTS



Effect of soy substitution on particleboard properties; n =12; ES =Edge swell; TS= thickness swell; WA= water absorption and IB = Internal bond strength.

## CONCLUSIONS

- Soy flour improved the tack of MDI to the level of UF resin.
- The IB and wet properties of the particleboards were not affected up to 20% soy flour substitution.
- MDI tack could be tuned with soy flour according to application but high substitution could lead to excessive tack. This will limit adhesive spread.

Acknowledgement

