Chemical recycling of semi-rigid polyurethane foam by using bio-based coconut oil glycerides as a solvent

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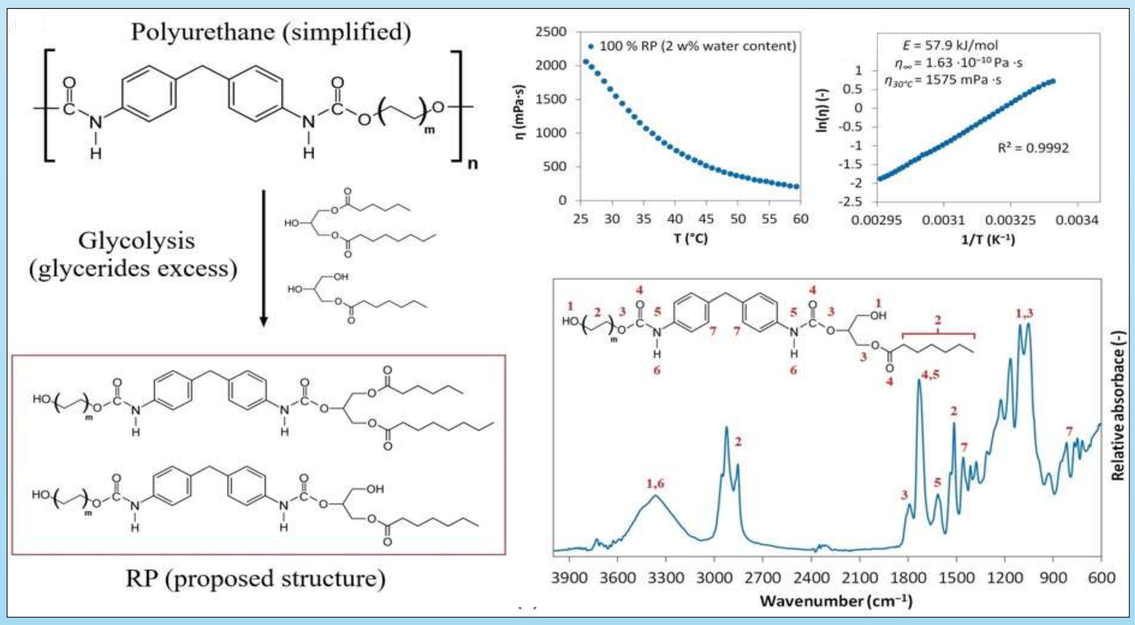
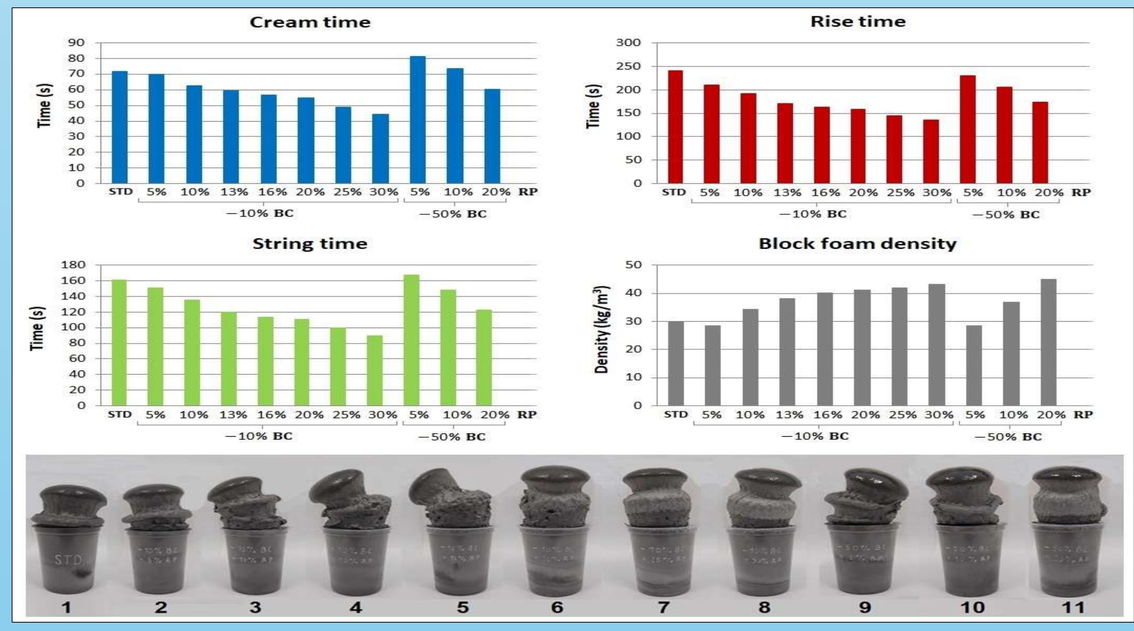
This paper investigates the influence of the usage of polyurethane (PUR) block foam waste dissolved via glycolysis in mono/diglycerides of biobased coconut oil on the properties of the PUR system. Gained recycled polyol (RP) was added to the standard polyol, and the mixture was used to manufacture the new PUR systems. Several variations of new PUR systems with different contents of recycled polyol were tested for characteristic parameters such as reactivity, foam dimensional stability and density, as well as for mechanical properties. Selected samples were tested on an up-scale as a block with dimensions 0.5x0.5x0.5 m.



Characteristic parameters of RP		
Parameter	**Unit**	**Value**
Hydroxyl number	mg KOH/g	436.7
Amine Value	mg KOH/g	76.8
Acid number	mg KOH/g	1.2
Water Content	wt%	2.0

Viscosity development	
Mixture	**$\eta_{30°C}$ (mPa·s)**
STD 3943/134/LD	1174
-50 % BC + 5 % RP	1154
-10 % BC + 13 % RP	781
-50 % BC + 20 % RP	658

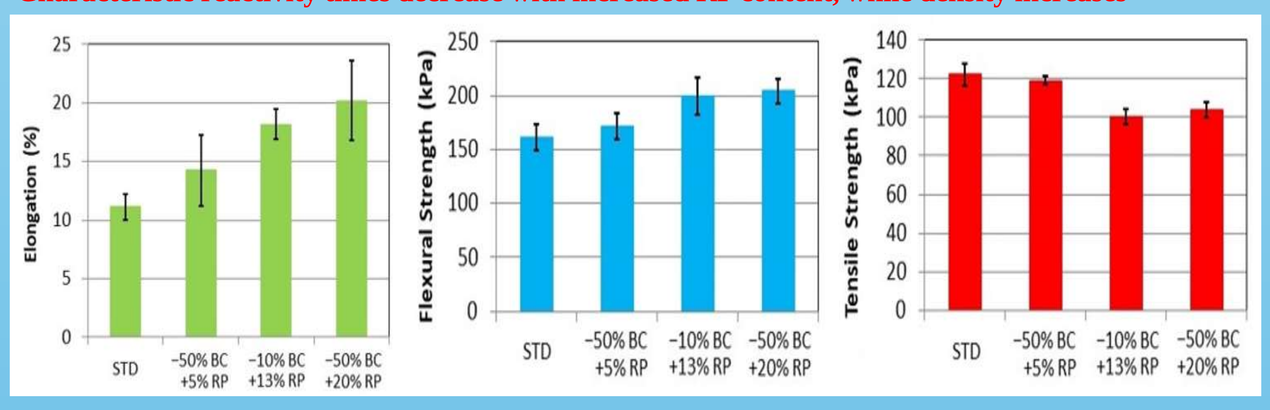
Viscosity decreases with increased RP content



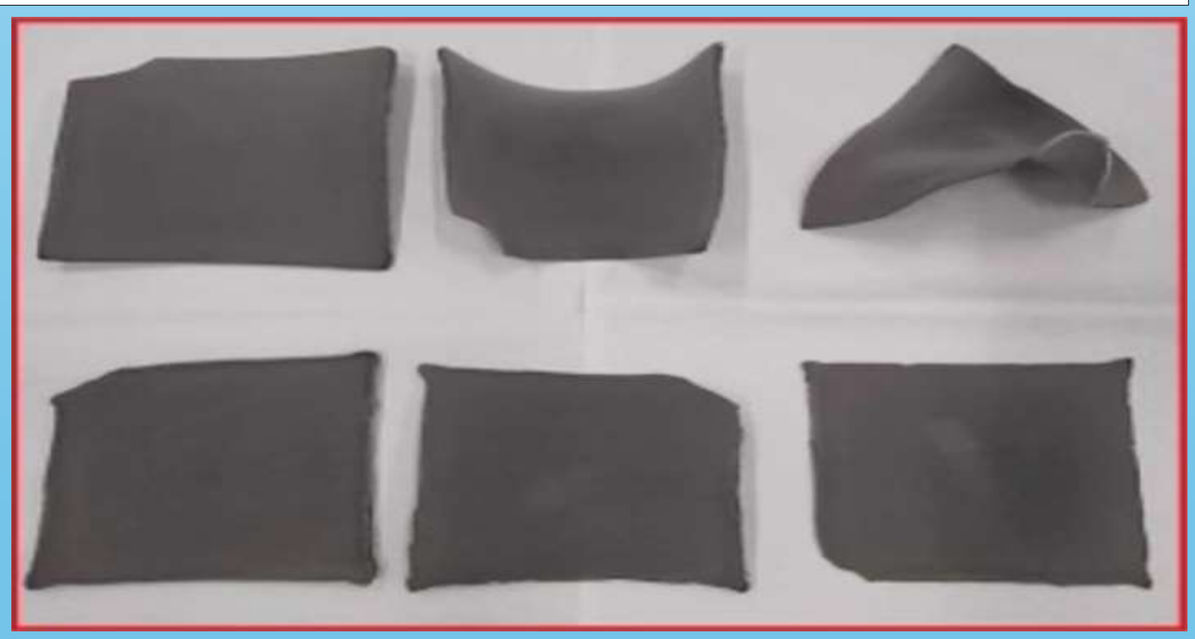
	System	STD Content (%)	RP Content (%)	BC Content (%)	Mixing Ratio (w/w)	Hydroxyl Value (mg KOH/g)	Amine Value (mg KOH/g)
*1	STD 3943/134/LD	100	0	100		288.0	2.3
2	−10 % BC +5 % RP	95	5	90		301.2	5.8
3	−10 % BC +10 % RP	90	10	90		305.8	9.2
*4	−10 % BC +13 % RP	87	13	90		308.2	11.5
5	−10 % BC +16 % RP	84	16	90		314.9	13.3
6	−10 % BC +20 % RP	81	19	90	100:170	316.9	15.8
7	−10 % BC +25 % RP	75	25	90		328.3	20.1
8	−10 % BC +30 % RP	70	30	90		333.0	24.0
*9	−50 % BC +5 % RP	95	5	50		305.0	5.7
10	−50 % BC +10 % RP	90	10	50		307.0	9.2
*11	−50 % BC +20 % RP	80	20	50		317.5	15.3

BC ... blowing catalyst
** ... systems tested in up-scale*

Characteristic reactivity times decrease with increased RP content, while density increases



Elongation increased significantly



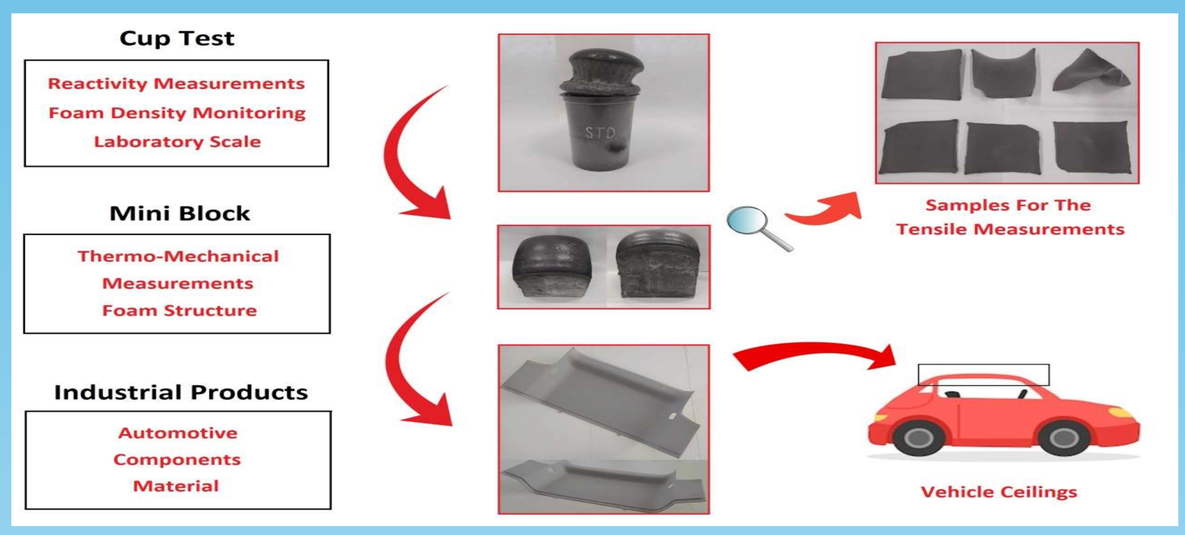
Foam wrapping due to higher content of RP (amine content)

Conclusion

Numerous studies investigated the recycling of PUR foam via glycolysis with different results regarding mechanical properties. This study investigated PUR systems with a mixing ratio of 100:170 polyol to isocyanate.

1, Viscosity decreases with an increasing content RP and in the standard polyol
2, Characteristic reactivity times decrease with increasing RP content
3, The elongation of foam significantly increased with a higher content of RP in the PUR system, while tensile strength dropped by 20%.
4. Foam wrapping observed in case of higher RP content in PUR system

Although some properties such as wrapping are negative, PUR foam glycolysis with long aliphatic chain solvent is a promising recycling method for industrial usage.



Up-scaling concept

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