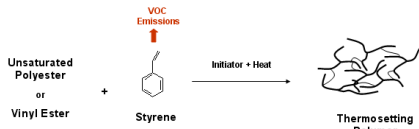


CHEMICALLY MODIFIED FATTY ACIDS AS STYRENE REPLACEMENT IN VINYL ESTER POLYMERS

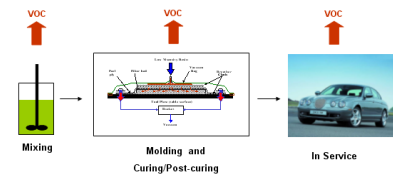
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INTRODUCTION



- Liquid resins used in molding are a significant source of VOC emission.

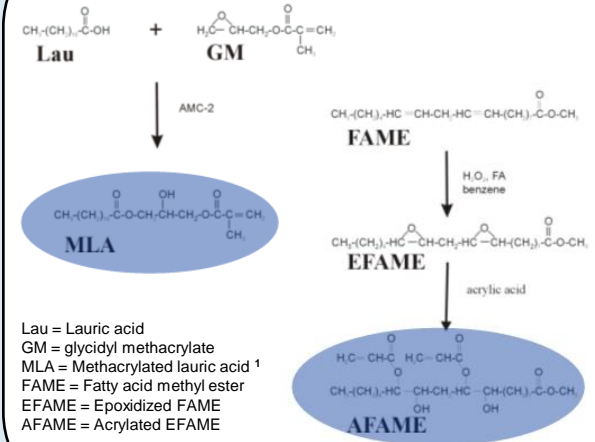


- Federal Environmental Protection Agency introduced legislations to limit styrene emissions

OBJECTIVES

- Eliminate styrene concentration because it is a hazard air pollutant (HAP) and a volatile organic compound (VOC)
- Employ a fatty acid monomers as an alternative to styrene in the production of vinyl ester polymers
- Produce a resin that can be employed in liquid molding (0.2 Pa.s < viscosity < 1 Pa.s)
- Produce a polymer with good properties

FATTY ACIDS MONOMERS (FAM)



¹La Scala J.J. et al., *Polymer*, 2004

RHEOLOGICAL PROPERTIES

	VE (wt.%)	FAM (wt.%)	η (Pa s) ²	Ea (kJ/mol)
AFAME	15	85	0.22	43.7
	30	70	0.45	50.8
	50	50	2.95	81.5
	70	30	14.3	75.8
	85	15	71.9	86.1
MLA	15	85	0.212	41.7
	30	70	0.41	45.4
	50	50	1.57	54.4
	70	30	12.1	70.4
	85	15	68.9	85.2
Styrene	70	30	0.8	52.1

MECHANICAL PROPERTIES

	VE (wt.%)	FAM (wt.%)	T _g (°C)	E' (MPa) ²	ν (mol/m ³)	Mc (g/mol)
AFAME	15	85	70.8	367.0	250.0	4399.9
	30	70	81.2	818.6	693.5	1586.1
	50	50	94.9	1562.2	2136.5	514.9
	70	30	112.6	2245.2	3605.3	305.1
	85	15	126.2	2731.6	4971.2	221.3
MLA	15	85	56.7	280.53	94.1	11689.7
	30	70	68.1	741.29	442.9	2483.6
	50	50	86.1	1252.8	1623.1	677.7
	70	30	103.1	2158.0	3521.2	312.4
	85	15	113.7	2626.6	4507.3	244.0

² 30 °C

- Rubber elasticity theory:

$$E' = 3 \nu R T = \frac{3 \rho R T}{M_c}$$

- ↑ MLA
 - ↓ T_g and ↓ E'
 - ↓ ν and ↑ M_c
- VE copolymerized with 30 wt.% of styrene:
 T_g of 139.9 °C
 E' of 2915 MPa (at 30 °C)

CONCLUSIONS

- FAM can be used to reduce styrene concentration, reducing VOC emissions, health and environmental risk.
- The addition of FAM at the expense of styrene increased the viscosity of liquid resins and decreased both the T_g and modulus.

ACKNOWLEDGEMENTS

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