Tailoring new adhesives for Cultural Heritage conservation.

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INTRODUCTION

New consolidating adhesives, specifically tuned for painted works of art such as easel paintings, polychrome wooden sculptures and decorations where adhesion failures may occur among different paintings or between the layers and the support, are being investigated in this work. Usually, adhesives are made up with a polymeric base and, in lower concentration, a tackifing resin, which increases the wet capability and the tack properties of the blend. Other additives such as wax, stabilizers, thickeners or plasticizers may be added to improve the adhesion properties or the stability of the final product.

Cracking and lifting

Delicate and powdering paint layer

Aim of the project

- Understanding the interactions and roles among the adhesive components in order to design simpler and affordable formulations;
- testing new formulations made by mixing suitable polymers already employed in other fields with more stable tackifiers (binary mixtures);
- correlating the long term stability of the different materials with their miscibility features and adhesive performances.

CONCLUSION AND FUTURE DEVELOPMENT

The analyses that so far have been carried out revealed the importance of the tackifier behavior and its compatibility with the polymeric phase. Interactions between tackifier and polymer determine, definitely, the performance of the adhesive. DSC and rheological measurements can help in identifying the compatibility between the components and finding the best application conditions (temperature range, use of heat or solvent) or even in predicting mechanical properties before conducing mechanical tests.

Characterization is still on going.

EXPERIMENTAL AND METHODS

Binary mixtures

In this phase of the research, 16 binary mixtures with 70% w/w of polymeric base and 30% w/w of tackifiers have been prepared mixing together the components in an appropriate volume of xylene at 50°C under agitation for an hour.

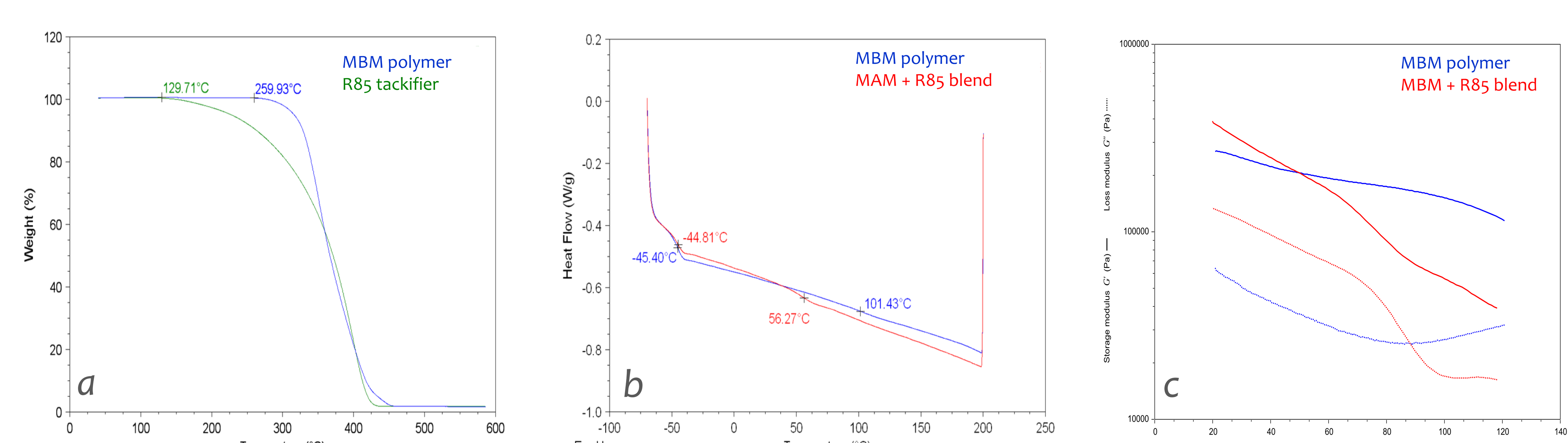
Selected components

Polymeric base	Tackifiers
ethylene vinyl acetate copolymers (EVAc)	Hydrogenated hydrocarbon resin
ethylene butyl acrylate copolymers (EBA)	Ester of hydrogenated rosin
acrylic triblock copolymers (PMMA-BA-PMMA; here MBM)	Urea-aldehyde resin

Analytical characterization

Pure components have been chemically and physically characterized in order to study how interactions between them modify the properties of the main compound and how the properties of the adhesive change according to their chemical nature and their concentration (this will be a second phase of the research). Same analyses will be carried out after accelerated ageing. In particular:

Chemical characterization	Physical characterization
Infrared spectroscopy (research of separation of phases and chemical interaction, modification after accelerated ageing)	Peel test (characterization of bonding strength)
Thermal analyses (TGA and DSC; peculiar temperatures, emergence of more than a phase in the blend, thermal stability)	Tack test (capacity of the adhesive to form a bond with a surface)
Rheological properties (tack and peel strength, viscoelastic properties)	Creep test (creep or stress relaxation behavior)
Solubility test (change in polarity due to chemical degradation after ageing)	Stress-strain curves (viscoelastic properties)



Analysis carried out on an MBM polymer and on the tackifier R85, a hydrogenated hydrocarbon resin:

a) *TGA curves show the degradation after heating in nitrogen atmosphere; the analysis is useful to find the proper range of temperature at which DSC and rheological tests can be performed.*
b) *DSC curves of the polymeric base along with the blend obtained mixing it with R85; while the curve of the pure polymer shows the Tgs of the PBA and the PMMA blocks (-45°C and 101°C respectively), the curve of the blend results having a change of the second Tg (56°C) due to a plasticizing effect of the resin on the PMMA phase.*
c) *Storage and loss moduli of the MBM polymer and of its blend with R85; the addition of the tackifing resin lowers the moduli values, in particular in the domain of the PMMA (high T). Since the storage modulus is always greater than the loss one, the application of a similar adhesive on artistic substrates needs solvent and cannot be made by heat activation.*