

# Obsolescence of adhesive – which solution for tomorrow?

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Adhesive bonding become more and more common in all industries. Bonding is a specific process which requires dedicated tools and methods, qualified processes and trained operators, representing a substantial investment for companies.

For these reasons, industrialists and manufacturers are always looking for more sustainable bonding solution and obsolescence remains an issue for all final users of adhesive technologies.

Several reasons can lead to an adhesive obsolescence. In a first place, it can be a regulatory obsolescence. One of the most common regulation, REACH, requires registering chemical substances used, manufactured or imported in Europe. REACH manage the identification of substances of very high concern like CMR (carcinogenic mutagen and reprotoxic), endocrinian, PBT/vPvB (persistents, bioaccumulative and toxic). REACH can also restrict the use of substances listed in Annex XIV, candidate list and SVHC (Substance of Very High Concern).

Some regulations are more specific to a business domain like:

- FDA / EC: Food & Drug administration for US and EC1935/2004 for EU. These regulations give marketing authorization for materials in contact with food or drug.
- RoHS: Restriction of Hazardous Substances Directive in electrical and electronic equipment.
- ITAR: regulatory regime that control importation and exportation of products/services linked to US national defence.

Obsolescence can also be economic. Adhesive are usually viewed as a niche market with low volume consumption. Main suppliers rationalized their product range. Most of adhesives are based on petrochemical materials, a non-renewable resource with recent price evolution.

In order to prevent obsolescence, several solutions can be considered as regulatory monitoring or the use of alternative of petrochemical raw materials.

In order to illustrate this approach, works performed in Rescoll laboratory will be exposed:

- PUR hot-melt adhesive based on recycled raw materials
- Formulation of bio-sourced epoxy adhesive

## 1.1. Formulation of adhesive from recycled raw materials

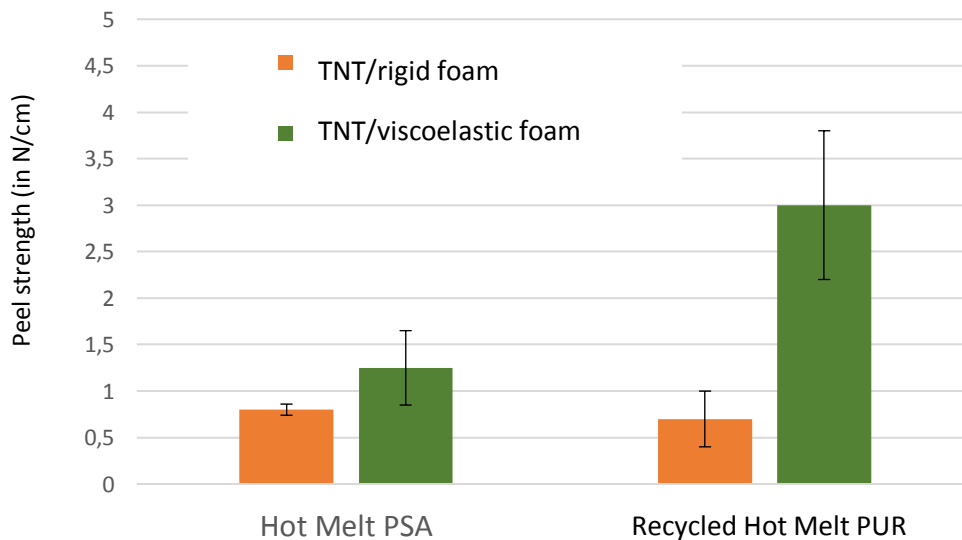
RESCOLL is involved in the European project URBANREC dedicated to develop and promote management of urban waste. Objectives were to decrease 50% of urban waste emission, develop innovative products based on recycled materials and create new network.

One the work-package of this project was to recycle mattress foam mainly made with PU foam using an innovative process to transform raw PU foam in recycled polyols. These recycled polyols have been used to formulate polyurethane adhesive for mattress bonding.

Foam mattress bonding is usually done with hot-melt adhesive like PSA. We choose Hot-Melt PUR technology in order to valorise recycled polyol and have a technology adapted to the actual bonding process.

We succeed to formulate Hot-melt PUR adhesive with 60% of recycled polyols. Nevertheless, petrochemical raw materials are still necessary in order to obtain high performance properties compatible with industrial curing process.

As show below, peel strength of recycled HM-PUR are equal or superior to HM-PSA usually used in foam mattress bonding.

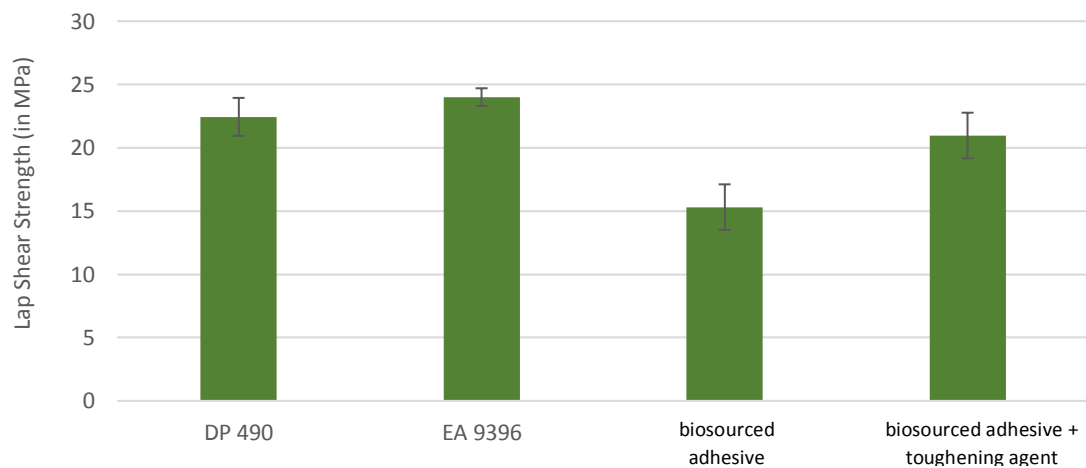


## 1.2. Formulation of bio-sourced adhesive

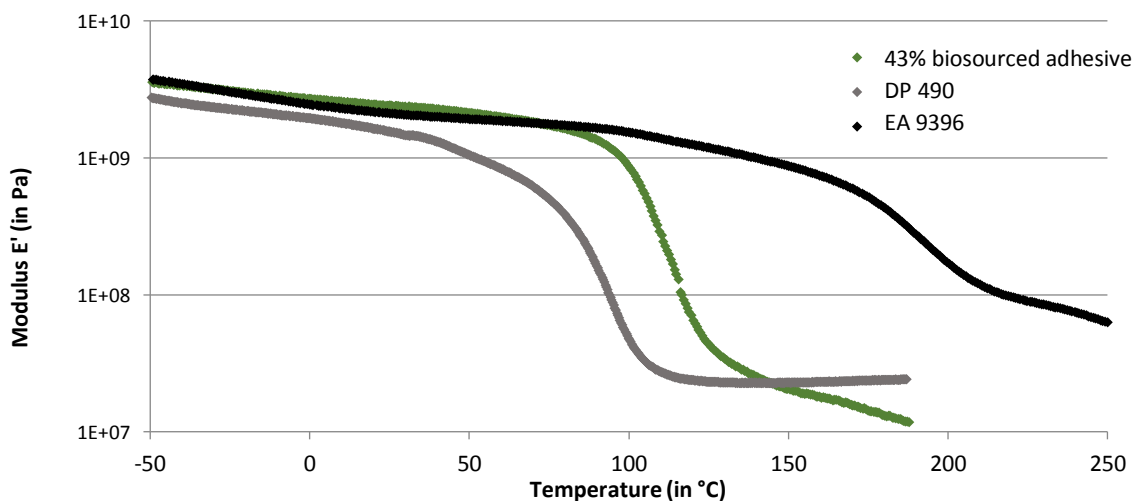
Epoxy adhesive are one of the most common used adhesive in industries. Even if consumption of biosourced materials increases from 2005, there are no new biosourced products in adhesive domain.

Many biosourced epoxy resin on the market are derived from vegetal oil, polyols, lignin, ... usually they are more dedicated for floor coating due to their flexibility, low Tg and moderated modulus. Partially biosourced epoxy resins are synthesized from biosourced epichlorhydrin and their properties are similar to petrochemical DGEBA resin. Combine with hardener and toughener based on Cardanol, we succeed to formulate a structural adhesive with 43% weight of biosourced raw materials.

Adhesion properties have been tested on lap shear test after 7 days at room temperature. Lap shear strength of biosourced epoxy adhesive is around 20MPa on aluminium 2024-T3 plates with cohesive failure. These adhesion properties are similar to regular epoxy adhesive based on petrochemical raw material.



Thermal properties have also been characterized in Dynamic Mechanical Analysis or DMA from -50°C to 250°C at 1Hz and 10 $\mu$ m. Modulus E' of biosourced and petrochemical adhesive are below in function of temperature.



Glass transition temperature of biosourced adhesive is around 100°C. Common epoxy adhesive as DP490 display lower thermal properties than our biosourced adhesive.

## ***2. Conclusion***

Innovative adhesive with high properties can be formulated with recycled or biosourced raw materials but petrochemical materials are still necessary in order to fulfil final user requirements.

The use of alternative raw materials have some limitation. Usually, recycled or biosourced products are more expensive and can contain toxic substances (ex: BPA, epichloridrine, isocyanate, ...).

Alternative raw material is still a flourishing topic in public laboratory. Future recycled or biosourced raw materials need to be more competitive in term of properties and cost in order to make adhesive bonding solution more and more sustainable.