CHEMICAL RECYCLING OF EPOXY RESIN

The optimization of the Solvolysis setup to obtain Bisphenol A

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Epoxy Resin is a type of thermosetting polymer that solidifies after formation, which is unable to melt again [1]. These thermosets need to be recycled in order to limit the amount of waste being formed after use. There exist various methods to do this, but in this project, the focus will be put on the chemical recycling through a process called solvolysis [2]. This makes it possible to obtain pure Bisphenol A, one of the main chemical ingredients for the epoxy resin, which can then be reused to make new thermosetting polymers in the future.

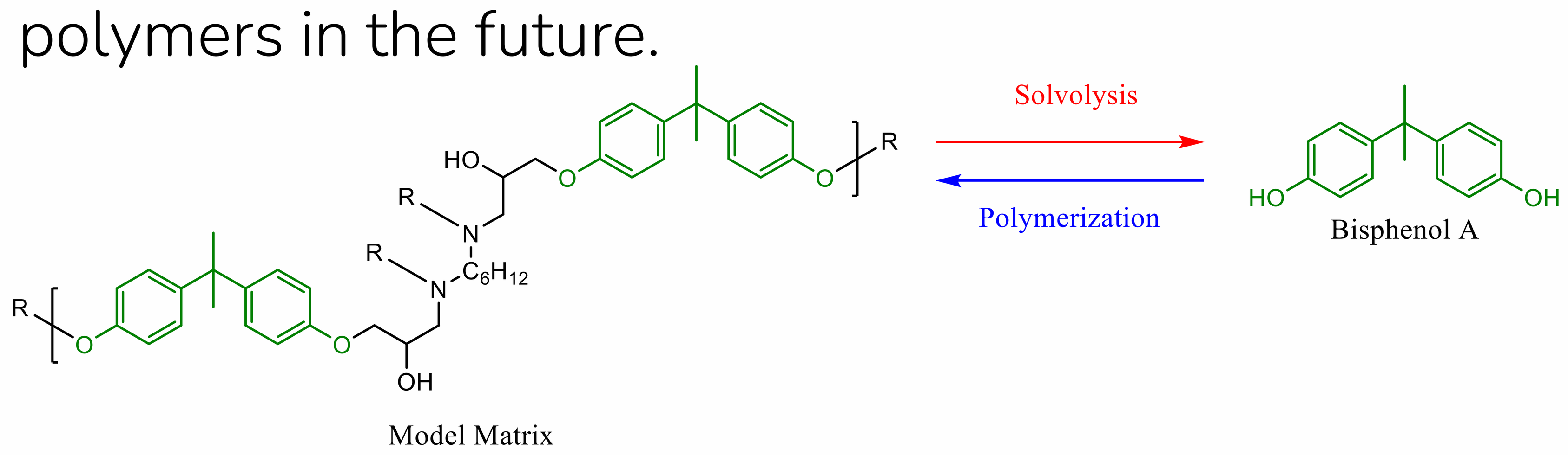

Figure 1: General reaction scheme of the Solvolysis process, alongside Polymerization.

Methodology

Figure 2: Photo of Epoxy Resin powder used during Solvolysis.

The solvolysis involves treating the epoxy resin with a solvent under a set temperature and time, which is then filtered afterwards. The pH is then stepwise lowered with concentrated acid, which causes Bisphenol A, along with other side streams, to be obtained from it. The produced Bisphenol A is then characterized using methods such as the HPLC, FTIR and the NMR.

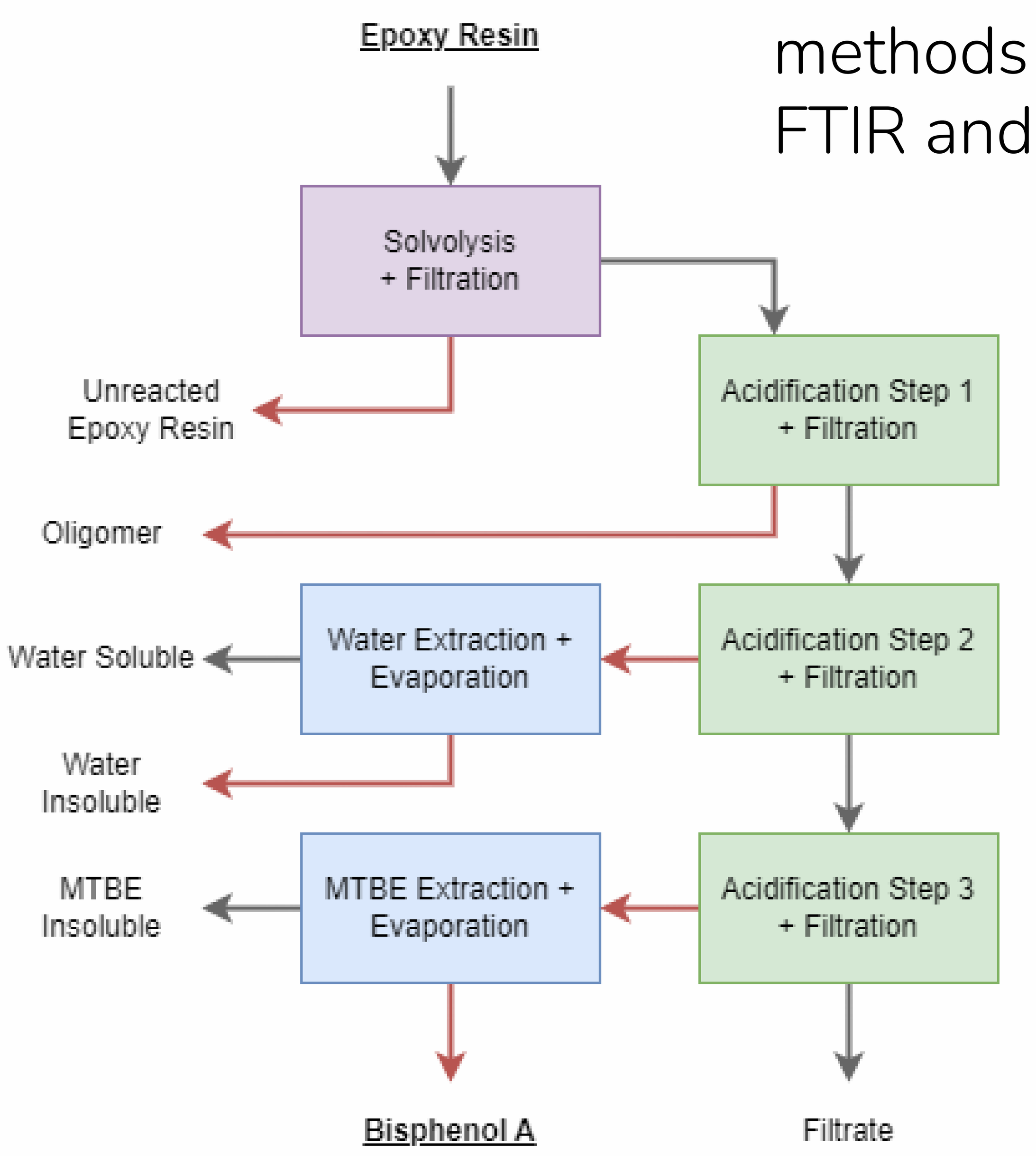

Figure 3: Flowchart of the Solvolysis, Acidification and Separation involved.

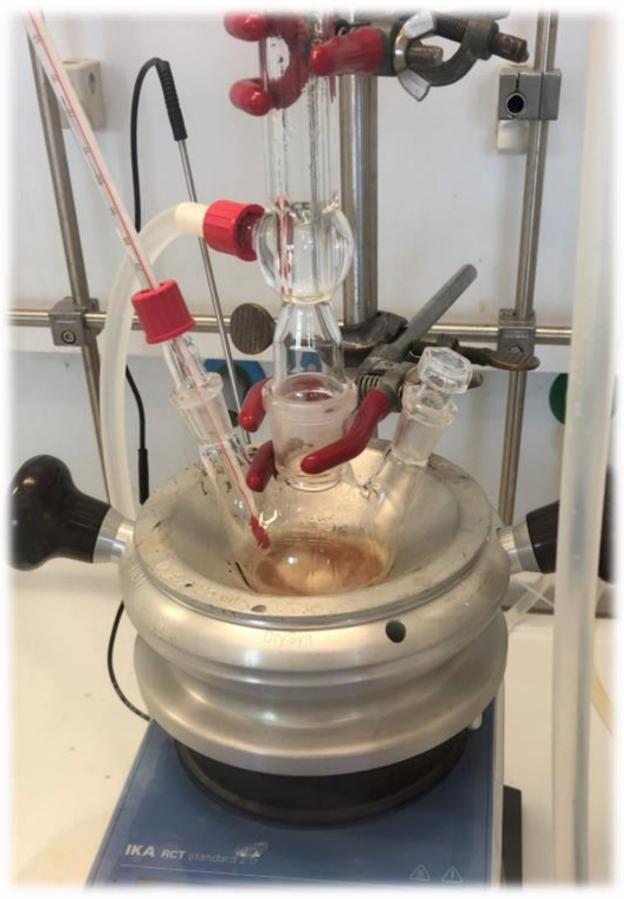

Figure 4: Photo of solvolysis setup.

Results

The solvolysis of 5 grams of Epoxy Resin has been calculated to result in around 1,17 grams of Bisphenol A, according to be HPLC (along with a yield of around 46,8%).

After the acidification, it is possible to obtain pure bisphenol A, as can be confirmed with both the NMR and the FTIR. The mass balance has been used to determine that 0,65-0,75 grams could be obtained after this final step (with a yield of 26-30%).

Figure 5: Photo of Bisphenol A obtained.

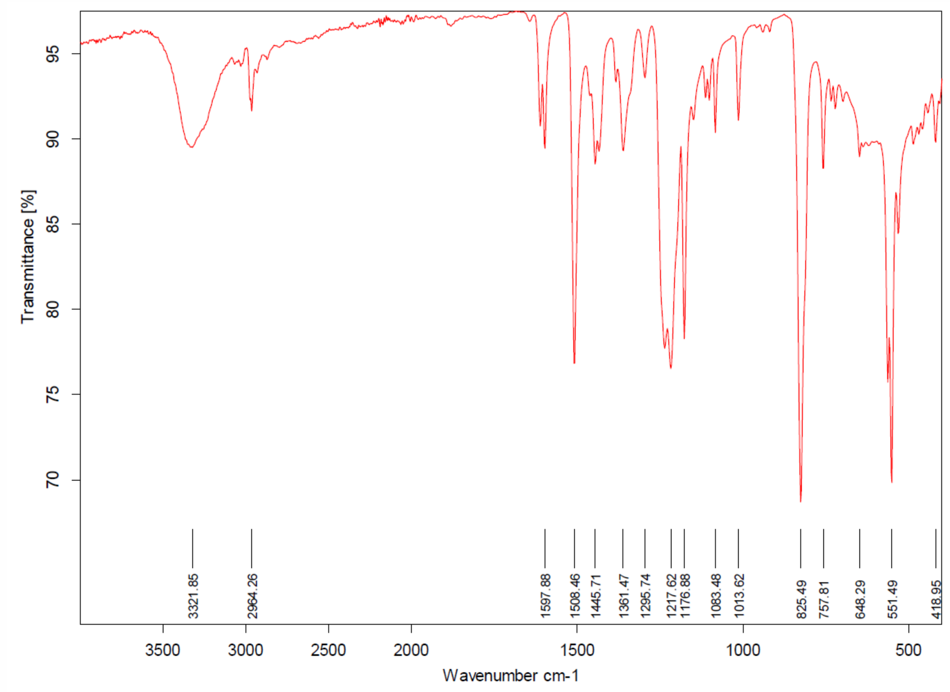

Figure 6: FTIR graph obtained from Bisphenol A.

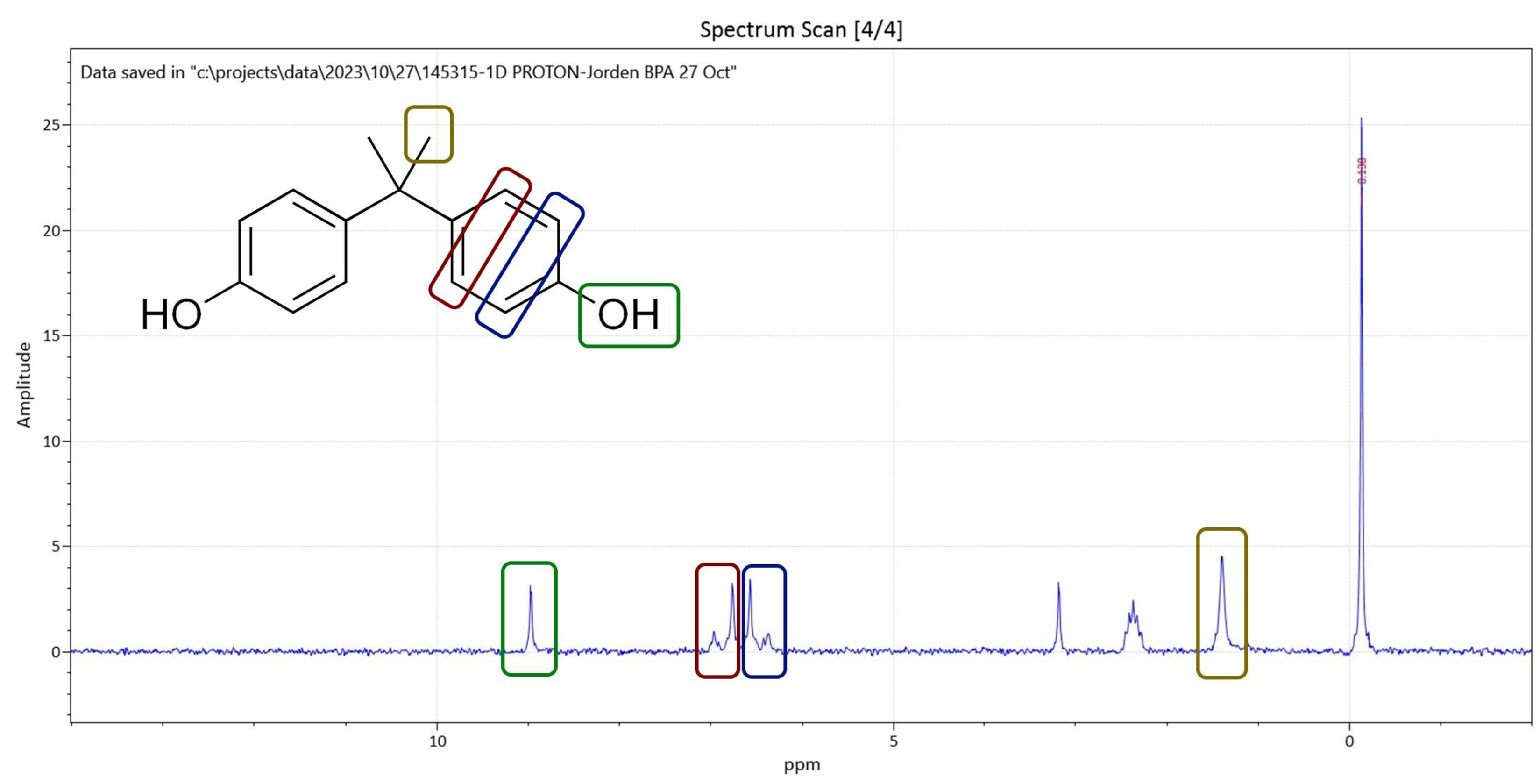

Figure 7: NMR graph of pure Bisphenol A obtained.

Conclusion

With the application of both the solvolysis and the acidification after that, it has been possible to obtain Bisphenol A as a pure component, making it reusable as a monomer for the polymerization of new Epoxy Resin. It has also been possible to determine the yield of the Bisphenol A that can be obtained from the Epoxy Resin.

References

[1] TWI, "THERMOSET VS THERMOPLASTIC (WHAT IS THE DIFFERENCE?)," TWI, [Online]. [Accessed September 2023].

[2] J. T. M. O. Eylem Asmatulu, "Recycling of fiber-reinforced composites and direct structural composite recycling concept," Journal of Composite Materials, 2014.