

# Designed polymers for purification of flavor oils in industrial scale

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## Introduction

'Designed polymers' are a class of selective polymer resins with built-in affinities for particular target molecules or 'classes' of molecules (Figure 1). Designed polymers are obtained by careful design of the required interaction chemistry. The choice of polymer building blocks is important to ensure that the required surface chemistry and material morphology, properties of an adsorbent that impact selective binding, are compatible with the application desired for a particular matrix. Molecularly imprinted polymers (MIPs) are one example of this type of polymers and are a novel class of selective resins with selective binding sites engineered to contain recognition elements in defined cavities<sup>1</sup>. Compared to antibodies or other selective ligands, MIPs and Designed polymers can perform in aggressive environments, in fully organic media, oils or under other non-standard or non-aqueous conditions.

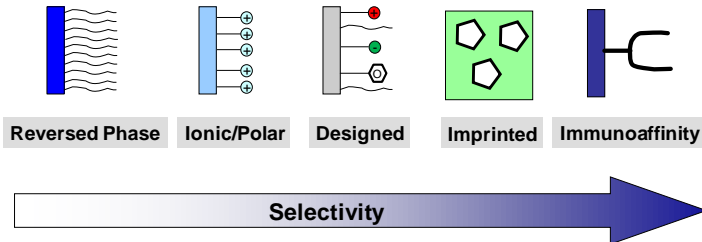


Figure 1. Designed Polymers and MIPs in relation to other separation materials

Our polymer resin library toolbox consists of designed resins and imprinted polymers. Those resins can contain different chemistries such as combinations of weak or strong ion exchange with neutral, hydrophilic and hydrophobic moieties (Figure 2).

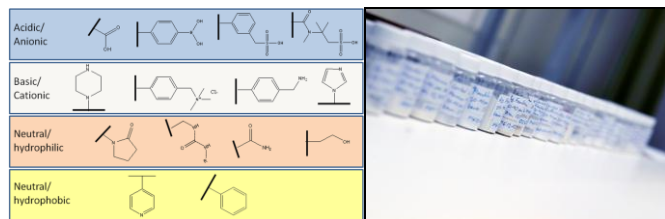


Figure 2. Depiction of surface resin chemistries – Polymer Resin Library at MIP Technologies AB

## Selective pesticide removal from citrus oils

A wide range of agricultural residues such as pesticides are permanently plaguing the food industry and are present as undesired contaminations remaining in products originating from eg fruits. One such example is the presence of minute quantities of organophosphate pesticides in citrus oils. Citrus oils are important ingredients in a large variety of food, beverage and fragrance products. Traditional clean-up methods utilizing standard unit operations are not effective in removing such pesticides without negatively affecting essential properties and characteristics of flavor oils.



MIP Technologies AB has developed a designed resin (RENSA™ 101) that has built-in engineered binding site cavities (Figure 3, Table 1) that are highly selective and recognize a large number of different organophosphate pesticides in citrus oils, which is a strongly hydrophobic, predominantly limonene/terpene environment.<sup>2</sup>

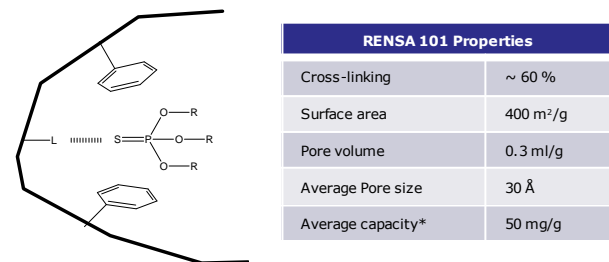


Figure 3. Schematic binding cavity representation of RENSA™ 101.  
Table 1: Material properties of RENSA™ 101. \*Average capacity is 50 mg pesticide bound per gram resin in citrus oil.

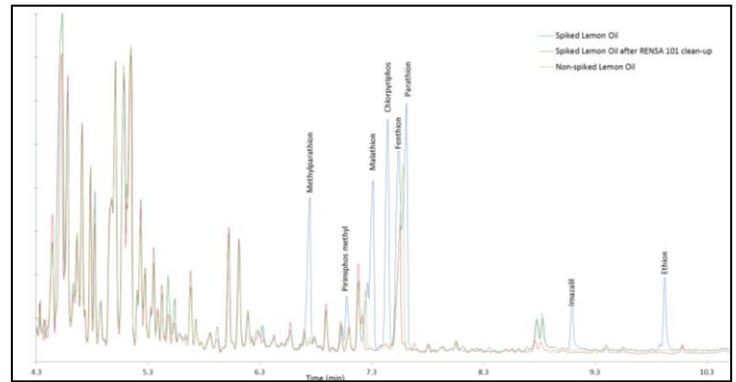


Figure 4. View of the total ions scan GC-MS chromatograms of the various samples of lemon oil

Figure 4 demonstrates the successful removal of eight pesticides from spiked lemon oil by passing the oil through a column with RENSA™ 101. The chosen pesticides (Figure 5) cover a variety of possible contaminants in citrus oils. After only a single pass through the polymer resin, the concentration of pesticides in the flavour oil is reduced to levels below the detection limit. In addition, important volatile constituents that elute early on are not affected by the treatment. Both flavor and taste profiles are kept intact after treatment with RENSA™ 101.

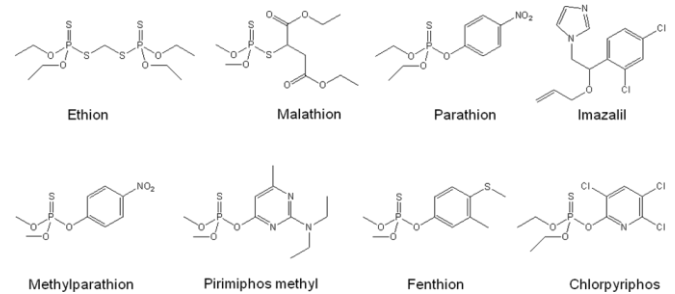


Figure 5. Structures of pesticide compounds selectively removed by RENSA™ 101. Most pesticides are organophosphates, but pesticides bearing an imidazole moiety (Imazalil) are also retained well.

## Designed Polymers for dedicated separations

An extensive range of scalable polymer resins is available at MIP Technologies (Figures 1&2). In close interaction with a client, these resins can be screened with the customers' compounds and optimized for their matrices (Figure 6). These industrial scale resins are available at both the lab-scale and also at larger quantities (kg) and can be scale-up further for pilot and process scale use.



Figure 6. The 3 stages of a typical custom design modular study. It covers the stages of Screening (1), Optimization (2) and Scale-up (3).

## Conclusions

- Designed polymers and MIPs are powerful resins for solving difficult extractions
- Designed polymers can be tailor-made to solve specific separations
- A wide range of resins are available at both g and kg scales and can be scaled up to even larger industrial quantities
- RENSA™ 101 is a new type of resin that is designed to effectively and selectively remove a wide range of pesticides from citrus oil matrices without affecting sensory properties such as flavor and aroma
- MIP Technologies has a successful track record of working closely with clients towards the screening, optimisation and scale-up of custom designed speciality resins

## References:

1. C. Widstrand et al., *American Laboratory News* October 2006
2. S. Jönsson, E. Yilmaz, S. Bejowich, EP2432588A1

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