CASE STUDY

How Syngene partnered with a bioengineering company to synthesize a complex, triblock copolymer to address biofouling issues

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The requirement

The client is a bioengineering company working on addressing the challenging and widespread issue of biofouling – the nonspecific attachment of unwanted biomolecules and microorganisms onto a surface – in industrial coatings. The client was looking for a suitable partner to synthesize a triblock copolymer using the reversible addition-fragmentation chain transfer (RAFT) technique to address biofouling issues.

The challenge

- Complex composition of the polymer involving the incorporation of three functionalized monomers
- Determining the percent incorporation of each block accurately
- Optimizing scalable processes without compromising on safety
- Short timeline of one month to deliver several kilograms of the desired polymer

The solution

Based on the recommendation of one of Syngene's existing clients, and an assessment of Syngene's expertise in polymer synthesis, including the RAFT technique, the bioengineering company decided to partner with Syngene.

RAFT is a controlled radical polymerization technique where the molecular weight is controlled using a special chain transfer reagent (CTA). The technique allows for better control over polydispersity, thereby helping to fine-tune the final polymer's properties.

Syngene undertook manufacturing of the Poly(PDMSMA)-b-Poly(PEGMA)-b-Poly(CBMA) triblock copolymer in a three-step synthetic process. It was done in a single pot using the sequential addition of monomers (PDMSMA, PEGMA, and CBMA).

For executing the project, Syngene conducted process development and scale-up activity of multiple batches in the lab along with scale-down studies. We also conducted Risk-Assessment analysis during the scale-down batch. Once it was safe, we performed a risk assessment at operating temperature.

Based on the batch experiment result and assessment of risk, we carried out the scale-up activity in Syngene's Kilo lab facility. We executed the project with a batch plan of 1 X 6 kg in a 50 L reactor, 2 X 3 kg in a 10 L reactor, and 1 x 13 kg batch in a 50 L reactor to deliver several kilograms of polymer to the client.

All the delivery batches showed better conversion in each block than what had been specified by the client. The molecular weight achieved was also in the customer-specified range.

The project was challenging due to the composition's complexity, which involved three different monomers. Further, each monomer had to be incorporated with a different degree of substitution. Syngene also had the challenging task of optimizing the scalable processes without compromising the safety aspects to achieve the desired polymer. The Syngene team overcame all these challenges, including determining the percent incorporation of each block using ^{1}H NMR, which involves tedious calculations.

Conclusion

The polymer synthesis was executed within a very short time (just one month), keeping in mind the urgency of the client's requirements. Within this short timeframe, the Syngene team established the polymerization process using the RAFT technique and completed the scale-down activity, risk-assessment analysis, and scale-up activity at Syngene's Kilo lab facility to deliver the final product to the client.

The client deeply appreciated Syngene's efforts in completing the project and delivering the polymer of the desired quality, on time.

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