Feeding Two Birds with One Scone: Regenerable Resin for Today's Treatment Goals and Tomorrow's Destructive Technologies

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Background/Objectives. Today's conventional approaches for treatment of PFAS-impacted waters generally lies with one of three technologies: granular activated carbon, ion exchange resin, or membranes (UF or RO) - or a combination thereof. Each of these technologies creates a residual waste stream requiring further treatment. The idealized end-state for treatment of PFAS is destruction which avoids concerns regarding future liability and is a more holistic approach from a life-cycle perspective. However, today's destructive technologies, although progressing, are not currently capable of treating significant volumes of water cost effectively. The use of regenerable ion exchange resin meets the two vital requirements: 1) the ability to treat large volumes of water ***today*** to meet treatment objectives and 2) the necessary production of a lower volume of highly concentrated PFAS matrix to treat with ***tomorrow's*** destructive technologies.

Approach/Activities. Although similar to single-use ion exchange resin, the processes for operating a regenerable resin system are different. Definitions and the different operating parameters for regenerable systems (forward flow and regeneration activities) will be discussed. Strengths and limitations of the regenerable resin system will be provided. Regenerable resin is not the panacea for all PFAS remediation applications - influent concentrations, particular treatment objectives and background water chemistry all have to be understood when considering this technology. The ability to significantly reduce waste generated will be discussed and presented in a quantitative manner. After resin regeneration, a small volume of highly concentrated waste remains. Treatment of 500,000 gallons water produces ~ 1 gallon solid waste needing further disposal or destruction. This has been demonstrated at full-scale facilities that have been in operation since 2017. Concentrated PFAS waste at a reduced volumes is an ideal candidate for tomorrow's destructive technologies. ECT2 has been working with academia and commercial entities to evaluate and enhance existing destructive technologies that perform best with wastes developed from regenerable resin operations. An overview of the most promising destructive technologies will be presented.

Results/Lessons Learned. Bench-, pilot- and full-scale data will be provided for regenerable resin systems that have been in operation since 2017. Data will be shared from both Australian and U.S. sites to include contaminant breakthrough data over time and resin performance over multiple regeneration cycles. Mass balances of PFAS removed versus recovered in the regenerable process will be calculated and shared. Cost curves will be provided. The considerations listed above (e.g., treatment objectives, targeted PFAS compounds (short- or long-chain), influent concentrations and water chemistry) and desired pay-back time, will determine when regenerable resin should be considered or when other technologies will be more cost effective. Finally, lessons learned from full-scale operation of regenerable resin systems over multiple years will be discussed and highlighted.