



## Preparing Biopharmaceutical Downstream Processing Supply Chains for Resiliency Post-Pandemic

From monoclonal antibodies (mAbs) that treat ailments such as cancer and arthritis to messenger RNA (mRNA) vaccines to fight a pandemic, biopharma's place in global healthcare has rarely been more prominent. By 2030 the global market for biopharmaceuticals is projected to reach \$856.1 billion and expand at a compound annual growth rate (CAGR) of 12.5% from 2021 to 2030.<sup>1</sup> In response to the increasing number of infectious diseases around the world antibody development is also fuelling tremendous growth in the biopharmaceutical manufacturing sector. According to the World Health Organization, approximately 41 million people die annually from non-communicable diseases, accounting for more than 80% of all deaths.<sup>2</sup>

However, the biggest driver recently has been the unprecedented response to the global COVID-19 pandemic. This massive effort to vaccinate the global population has sustained the spike in demand for resins to tackle a range of challenges, from creating active pharmaceutical ingredients (APIs) to purifying virus material for vaccines, to acting as excipients in drug formulations. Further, year-on-year growth in the demand for monoclonal antibodies (mAbs) to treat disease is also contributing to overall growth in the sector. Going forward, supplying this demand will become increasingly challenging and require a response from the entire supply chain, especially suppliers of critical materials and equipment.

Analysts note that among the enabling technologies the biopharmaceutical industry will need most are chromatography resins. They also note that in particular as demand for biologics continues to rise, so will the demand on the industry's resin suppliers to reduce supply chain risk, expand capacity globally and introduce higher performing, more efficient resin products, to serve the biopharmaceutical industry's growing need more efficiently and sustainably.<sup>3</sup>

### Resin's Crucial Role in the Biopharmaceutical Supply Chain

The biopharmaceutical industry uses chromatography resins for a wide variety of downstream processes including chemical and biomolecular isolation, protein purification for drug delivery, and diagnostics. Across pharma, food processing and commercial manufacturing, biomolecules and proteins of all kinds are purified and separated using chromatography resins.

Due to chromatography's critical role in downstream bioprocessing and separation, it is clear dramatic growth in the demand for biopharmaceuticals globally will continue to stretch and challenge the resin industry's supply chains.

### Answering the Global Demand for Effective Biologics

More drug developers need high-performance, cost-effective

chromatography resin technologies to help process biologics and bring them to market faster and more efficiently. Growth is expected to be significant. As a result, in 2022 the global resins market grew to \$2.3 billion and is expected to reach \$3.3 billion at a compound annual growth rate (CAGR) of 7.3% by 2027.<sup>3</sup>

This growth in the specialty resins segment over the last 12 months has been driven by several factors and has required innovation on the part of resin suppliers to meet changing biopharmaceutical demand.

As the industry moves through 2022 and beyond, demand for resins to support global vaccine and biopharmaceutical production can be expected to remain robust. That also means resin supply will become an even more critical aspect of the therapeutic biologics supply chain, which as it expands and demand grows, becomes even more prone to risk and disruption. This will likely drive innovation in the sector, as suppliers strive to develop products to meet customers' increasingly demanding bioprocessing needs while increasing their capacity and capabilities globally to assure quality supply at higher volumes.

### mAb Purification Development Trends to Stretch Suppliers

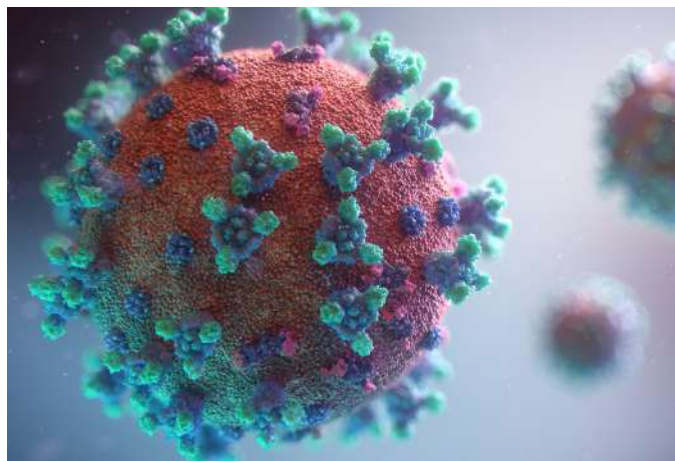
2021 saw the authorisation of two mAbs immunotherapies for emergency use by the FDA to treat COVID-19 symptoms in patients hospitalised by the disease.<sup>4</sup> Both treatments received full approval by the UK Medicines and Healthcare products Regulatory Agency (MHRA) this year.<sup>5</sup>

In fact, as of May 2021, the industry had reached a major milestone seeing the approval of 100 mAbs therapeutics since 1986.<sup>6</sup> Consequently, there has been an increase in demand for bioprocessing technologies to support this expanding and specialist development area. Resin manufacturing specialists have stepped up to meet the challenge by offering customer-focused innovation to meet this sector's unique needs. This is no easy task, as increasingly, the bioprocessing industry requires novel resin solutions that can optimise performance while reducing the cost of manufacturing.

### Innovative Resin Materials Helping to Future-proof Supply

For chromatographic mAb purification, agarose is widely considered the industry's gold standard. Agarose is frequently used to separate large molecules and DNA, typically through a combination of affinity and ion exchange chromatography steps. In chromatography, agarose can be formed into resin beads and used in a range of methods for protein purification. It is a useful material as it is extremely hydrophilic, is very stable under alkaline conditions, does not absorb biomolecules to any significant extent and has good flow properties. Further advantages of using agarose include:

- High tolerance to pH extremes
- Extremely hydrophilic – minimal unspecific binding



- Low matrix volume (4–8%) – possible to achieve high capacity
- Easy to conjugate – To address continuing demand for higher capacity Protein A and Ion Exchange resins, resin suppliers must continue to build on the gains in dynamic binding capacity the industry has achieved in the last decade.

Innovation by biopharma's resin suppliers is going to be needed across the landscape to address a growing list of critical challenges facing the industry now and in the future. Increasingly, biopharma needs resin solutions that offer unique performance benefits, economies, and efficiencies beyond what is available through current synthetic, natural and inorganic resin technologies.

### New Manufacturing Techniques Required

Upstream titres currently have a growth rate of 2.4% at manufacturing scale and 3.5% at clinical scales.<sup>7</sup> It's therefore vital that the chosen resin can meet these demands both now and, in the future, to account for growth and to mitigate supply-chain caused manufacturing bottlenecks in downstream purification.

The development of advanced resin manufacturing technologies is also an important hedge against future supply chain risk and technological needs. For example, recent innovations in greener, continuous manufacturing processes are producing chromatographic resin beads with uniform particle sizes for unique performance characteristics and significantly reduced environmental impact.

These innovations are providing more sustainable alternatives to traditional resin manufacturing techniques which also boost mAbs manufacturing efficiency. Like the biopharma industry, its resin suppliers must do their best to manage supply risk end-to-end. Continuous resin manufacturing methods can help to achieve this by reducing manufacturing times, meaning better capacity utilisation in the facility, more available manufacturing slots, and greatly reduced lead times.

### Supply Chain Agility and Resiliency

Supply chain resilience is more important than ever for biopharma manufacturing. As a result, manufacturers are continually seeking ways to protect their supply chains against ongoing uncertainties, and other geopolitical shifts.

A key strategy that larger manufacturers are employing is to source a second supply of critical raw materials (such as bioprocess resins), as well as ensure those suppliers have both domestic manufacturing and international manufacturing capabilities. This helps ensure supply chain risk is mitigated as much as possible.

From a global supply chain risk perspective when a resin supplier has more than one facility located in more than one country, it can help to ensure robust global distribution and business continuity as a hedge against risk – whether from a pandemic or social/geopolitical shifts.

### Reduce supply Chain Risk Strategically

When a global network of qualified resin suppliers with long-term supply agreements is connected digitally and aligned operationally, the risk of a supply disruption interrupting production and delaying supply becomes less likely.

The technologies and platforms making this possible are becoming easier to implement and more effective in engaging trading partners effectively. It is imperative that every supplier in biopharma's critical supply chain, especially resin suppliers, take their approach to supply chain operations and business processes very seriously.

### REFERENCES

1. <https://www.precedenceresearch.com/biopharmaceutical-market>
2. [https://www.who.int/data/gho/data/themes/topics/topic-details/GHO/ncd-mortality#:~:text=Noncommunicable%20diseases%20\(NCDs\)%20kill%2041,71%25%20of%20all%20deaths%20globally.](https://www.who.int/data/gho/data/themes/topics/topic-details/GHO/ncd-mortality#:~:text=Noncommunicable%20diseases%20(NCDs)%20kill%2041,71%25%20of%20all%20deaths%20globally.)
3. <https://www.marketdataforecast.com/market-reports/chromatography-resin-market>
4. <https://www.fda.gov/news-events/press-announcements/fda-expands-authorization-two-mono-clonal-antibodies-treatment-and-post-exposure-prevention-covid-19>
5. <https://www.ema.europa.eu/en/news/covid-19-ema-recommends-authorisation-two-mono-clonal-antibody-medicines>
6. <https://www.nature.com/articles/d41573-021-00079-7#:~:text=Thirty%2Dfive%20years%20on%20from,new%20drug%20approvals%20each%20year.&text=In%20the%20mid%2D1970s%2C%20immunologist,had%20a%20lab%20space%20problem.>
7. <https://www.bioprocessonline.com/doc/s-bioprocessing-year-in-review-key-takeaways-0001>



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