

Packaging: The First Line of Defence in Life Science Logistics

Temperature-controlled packaging plays a vital role in life science logistics.

Packaging has a multi-faceted role in supporting cold chain logistics to ensure transit times are met and the shipment is protected during handling. Unique packaging solutions have been developed to transport anything from sensitive biological materials during a clinical trial to life-saving medicines and cell and gene therapy treatments.

The appropriate packaging solution will ensure internal temperatures are maintained throughout global supply chains and that consignments remain viable to their final destination.

As more advanced treatments such as cell and gene therapy have become more complex and prevalent, there is an increased need for comprehensive packaging solutions that can maintain the integrity of a shipment in a wide range of conditions and, most importantly, alert supply chain specialists to any breach in the cold chain.

It is the first line of defence against temperature breaches and damage sustained during handling or tampering.



Industry Challenges

The global rollout of the COVID-19 vaccine demonstrated the need for robust cold chain logistics solutions in the face of a pandemic, with successful delivery and treatment reliant on packaging and transportation for a vast range of terrains and temperatures.

Research from the World Health Organization (WHO) underlines the global challenges the industry needs to overcome. WHO reports approximately 50% of vaccines globally are wasted, including the COVID-19 vaccine, and a proportion of those are damaged during transit and storage due to cold chain malfunction.

A greater risk of future pandemics, the climate crisis and an increasing reliance on personalised treatments, such as cell and gene therapies, are accelerating the need for innovative, sophisticated and validated packaging solutions that can help to mitigate these issues.

Packaging may be the first line of defence against temperature excursions, but how can specialists ensure thermal performance is maintained throughout the consignment's journey?

As global temperatures rise, and supply chains become more complex, cold chain packaging will inevitably have to work harder.

The nine years from 2013 through 2021 rank among the 10 warmest years on record, according to data from the National Centres for Environmental Information.

Identifying where cold chain malfunction occurs is the key to reducing the industry's biggest issues, including the occurrence of temperature excursions.

Cold Chain Packaging

Packaging for cold chain life science shipments is evolving to meet the growing

demand for specialist treatments. Vacuum-insulated packaging and phase change materials are just some of the complex packaging components that are being used to maximise the thermal performance of cold chain packaging during transit.

Packaging is carefully selected based on each consignment's unique requirements, with temperature profile, transit time and shipping lane data all analysed and evaluated to identify the right packaging requirement. Every packaging option must also be GDP compliant and ISTA7D tested – the temperature test for transport packaging managed by the International Safe Transit Association (ISTA).

Solutions have been developed to meet and sustain a comprehensive range of temperatures, from cryogenically frozen (-150°C and below) to refrigerated (+2°C to +8°C) and every temperature in between, while also providing protection from external factors like shock.

Tracking and Data

Increased connectivity through monitoring and tracking devices, as well as clear communication between supply chain partners and logistics coordinators, are one of the best tools the life science supply chain has in understanding where temperature excursions occur and how to overcome them.

Location tracking and the 5G wireless network allow for comprehensive live monitoring of a shipment, identifying delays on route that may increase transit time, and therefore, contribute to consignment damage.



Where do temperature excursions occur?

What external factors have impacted the performance of the packaging? These are important questions that only data can answer.

Having full sight of a shipment during transit enables specialists to intervene at the time of an excursion or take preventative measures, while improved customer visibility means increased customer confidence in the security and On-Time In-Full (OTIF) arrival of their materials.

This level of detail enables the logistics team to develop solutions that reduce or prevent the likelihood of an excursion happening by identifying preferred transit lanes and making informed decisions when selecting airlines and couriers.

Complex location tracking and condition monitoring in conjunction with predictive modelling technologies are the future of life science logistics.

These tools will become an essential component of life science packaging in the near future, as they can provide clarity where human communication falls short.

Ultimately, increasing industry-wide availability and use of condition monitoring technologies will help to prevent cold chain malfunction and increase OTIF rates to improve patient safety.

Closer Collaboration

Some of the biggest issues the life science community industry needs to overcome to improve OTIF rates and reduce product loss are related to disputations and delays in the commercial airline industry.

The COVID-19 pandemic severely disrupted the air transport sector, grounding 66% of global air fleets at its peak and reducing air freight capacity by 25% from 2019 to 2020. This major reduction in capacity resulted in air cargo rates increasing by 500% according to Dan Morgan-Evans, global cargo director at Air Charter Service (ACS) and placed additional pressure on the life sciences sector to balance transit speeds and spiralling costs.

Consignments are most at risk before and during airline transit. Airport security checks can present hazards for consignments. Clear communication and full customs clearance are vital to prevent fragile consignments such as cell and gene therapies from being x-rayed, which can make materials unviable and may result in serious repercussions for patients relying on life-saving treatments.

Improvements to packaging, such as the inclusion of security seals and eye-catching labelling, only go so far in preventing these types of exposure and potential damage to consignments.



Closer collaboration and training provide a short-term solution to overcoming these issues, but there is a bigger part for data to play in improving decision-making for logistics coordinators.

Tracking technology can highlight delays in transit, but while sophisticated condition monitoring technology has been developed, greater availability and reliability across the industry is required to confirm the viability of a consignment throughout transit.

Currently, technology exists to provide this level of detail, which could help specialists to intervene to prevent a consignment being delivered that is unsuitable for use, but it is not being widely used across the industry.

Condition monitoring devices with sensors that confirm exposure to light and shock are a game changer for the industry and for patients relying on biopharma treatments.

Resource and cost efficiency remains the priority for organisations, but greater investments in these technologies and global uptake will enable the whole industry to accurately plan and identify the safest shipping routes for life science materials.

Supply chain specialists will also be empowered to take remedial action where consignments may have been exposed and potentially damaged and intervene to replace shipments during transit.

Sustainability

Like all industries, life sciences logistics managers are facing increased pressure to reduce their environmental impact and improve sustainability.

Some packaging types have gained negative connotations in recent years, with discussions focused on the global requirement to reduce plastic and single-use packaging.

The association of less packaging with sustainability has become synonymous across most industries. In the life science sector, this presents huge challenges, as less typically means reduced protection and a reduction in transit times.

New developments in packaging materials that are smaller or lighter, but can perform to the same standards, are slow.

A move towards smaller packaging is likely to be detrimental to the consignments



being transported, with a loss of thermal performance increasing the likelihood of shipments arriving damaged.

So, in an industry where a reduction in materials is likely to have a detrimental effect, how do you make strides towards sustainability?

By prioritising viability.

We believe one of the industry's primary sustainability focus lies with optimising OTIF rates.

By not compromising on packaging, supply chain specialists can ensure that consignments arrive in a viable condition.

Delivering damaged materials presents serious issues for patients, but it also presents environmental issues, as any consignment that cannot be used requires re-shipping.

Product loss doubles the use of packaging and coolants, such as liquid nitrogen or dry ice, and emissions from couriers and airlines.

The type of accurate and real-time data that full condition monitoring could provide is the key to improving sustainability in the life science logistics industry and highlighting ways to mitigate product loss before it occurs.

Building Resilience

Data is central to the future of life science and biopharma packaging, and its ability to increase resilience.

WHO data on damaged vaccines underlines the need for greater insight into the issues facing the cold supply chain and the role that packaging can play in improving transit times to help reduce wastage and improve patient treatments.

Climate change and its impact on global temperatures will place more strain on the cold supply chain, meaning that packaging will need to undergo more extreme testing if



it is to deliver the same thermal performance in the future.

Predictive technologies that support at the pre-planning stage will become vital in forecasting what will happen during a shipment and where the biggest risks lie.

Digital models that can analyse temperature in real-time and predict the impact of extreme conditions will enable specialists to calculate a more accurate picture of how different packaging solutions will perform.

Adopting increased data gathering will also lead to digital decision-making, with programs designed to evaluate red flags and re-route where it predicts issues are likely to occur.

Having the technology to predict delays, high traffic, or even grounded flights due to adverse weather, would provide greater insight and improved decision-making to identify the shortest route with the least risk.

Overall, greater investments and developments in tracking technology will create more robust supply chains and improve patient safety as the industry grows.



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