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BIOLOGICS MANUFACTURING CENTRE VACCINE PRODUCTION

The Biologics Manufacturing Centre is designed to produce cell-based biopharmaceuticals like vaccines and other biologics, including viral vector, protein subunit, and virus-like particles and other recombinant proteins.

HOW DO VACCINES WORK?

The goal of a vaccine is to introduce small, safe amounts of antigens to the body. This helps the immune system recognize them as hostile and develop antibodies, which help protect the body from future infections.

In the case of SARS-CoV-2, the virus that causes COVID-19, the antigen being used by most vaccines is called a viral spike protein.

ANTIGEN PRODUCTION

To make millions of doses of a vaccine, large quantities of the cells that produce the antigen need to be grown.

This growth is done using bioreactors, where conditions like temperature and oxygen levels can be tightly controlled to provide optimal conditions.

The cell cultures grown in bioreactors can be scaled up to high volumes by transferring them to successively larger bioreactors.

In the Biologics Manufacturing Centre, the cells can initially be grown in a 20L vessel before being moved to a 200L bioreactor for further growth.

When the desired cell density is achieved, they can be transferred into a 2,000L bioreactor for final production, which is the largest in the Biologics Manufacturing Centre. It holds roughly the equivalent of 12 standard bathtubs.

It can take several weeks for the cells to fully expand to sufficient numbers to be ready for the next step. The technical term for this cell growth phase is **up-stream processing**.

SEPARATION AND PURIFICATION

Once the cells have grown to sufficient numbers, the cell culture is then separated, so that only the parts needed for the vaccine are kept. Everything else is discarded.

At this point, the cell mixture is still complex and needs to be purified so that only the desired product — the antigen — remains.

One technique used to help purify the cell mixture is chromatography, a process that separates the mixture into its individual components, resulting in the isolation of pure antigen. Any contaminants and impurities are discarded.

The separation and purification process takes approximately five to seven days. This is called **down-stream processing**.

Once the down-stream processing steps are complete, the result is the medically active — and most important — ingredient of the vaccine. Called the **drug substance**, this is what makes the vaccine work.

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It may be the most important part of the vaccine, but the drug substance is not actually the largest ingredient.

Most vaccines consist of mostly very pure water, which is added as part of the formulation process using a water for injection system.

FORMULATION

The **formulation** process is where the scientists work to stabilize the drug substance and dilute it to the concentration needed for final use.

Certain vaccines contain an adjuvant, a substance that enhances the body's immune response to an antigen. Added during the formulation process, adjuvants can help make a vaccine more effective.

Once the formulation process is complete, the result is called the **drug product**. This is the actual vaccine solution.

FILL-AND-FINISH

The vaccine solution is subsequently moved to a fill-and-finish area, where it is distributed into sterile vials using specialized machinery called aseptic filling equipment.

Each vial is carefully inspected, then closed, labelled, packaged, and put into cartons on pallets.

The vaccine is ready to be shipped to its next destination.

QUALITY ASSURANCE

Compliance with Good Manufacturing Practices (GMP) is an integral part of the design and operation of the Biologics Manufacturing Centre.

GMP requires that the **people**, **premises**, **processes**, **products**, and **procedures** involved in making a vaccine are doing exactly what they are supposed to do with repeatable precision.

With an end product intended to be administered to people, absolute compliance is required to ensure vaccines produced in a GMP facility are consistent in safety, identity, strength, purity, and quality — every single dose, every single time.

Ongoing quality assurance and quality control, including constant testing and verification, ensure this compliance, supported by solid documentation at each step in the process.

GMP compliance and exhaustive quality assurance protocols are essential to ensuring the products produced in the Biologics Manufacturing Centre will be safe for human use.

This high-level overview of vaccine production in the Biologics Manufacturing Centre is intended for general information purposes only. An extensive technology transfer process from the vaccine developer will determine the exact methodology required for each specific product produced in the facility.

CONTACT

Media Relations
NRC.MediaRelations-RelationsMedias.CNRC@nrc-cnrc.gc.ca

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