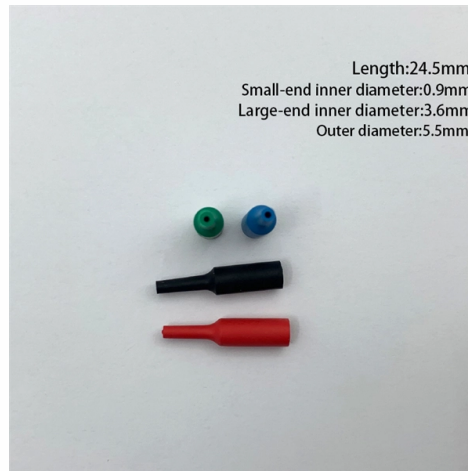


Highlights of the Circulation and Purification Module



Overview

During renal replacement therapy, blood circulates through an extracorporeal circuit, in which the site of purification is a filter.

Key Takeaways

The Circulation and Purification Module integrates fluid circulation and filtration principles to remove contaminants, inspired by human biological systems and applied in air, water, and blood purification technologies.

Key Features

Biomimetic Inspiration: The module often draws from the human circulatory and respiratory systems, which efficiently transport gases and remove waste products. In air purification, microbubble-based systems mimic alveoli and capillary networks to continuously remove particulate matter, volatile organic compounds, and carbon dioxide while supplying fresh oxygen, maintaining indoor environmental homeostasis (SNU research). **Fluid Circulation Mechanisms:** Circulation is central to purification.

In the glymphatic system of the brain, cerebrospinal fluid flows through perivascular spaces, driven by aquaporin-4 channels, to remove metabolic waste and maintain neural homeostasis. This principle informs designs in both biomedical and environmental purification systems. **Purification Techniques:** The module employs filtration, adsorption, and chemical-free biological processes.



For example, grey water recycling systems use bio-filters to clean wastewater without chlorine, enabling reuse in energy- and water-autonomous facilities. In medical applications, extracorporeal blood purification circulates blood through specialized filters to remove toxins and inflammatory mediators in sepsis management.

Efficiency and Sustainability: By combining circulation with targeted purification, the module enhances efficiency and reduces environmental impact.

Air purification systems inspired by human physiology have demonstrated reductions in CO₂ levels by 30% and improved activity in experimental models, highlighting both functional and ecological benefits. Applications: Environmental: Water recycling in self-sufficient laundromats and swimming ponds using bio-filters. Biomedical: Glymphatic-inspired therapies for brain waste clearance and extracorporeal blood purification in critical care.

Indoor Air Quality: Circulatory-inspired air purification systems for enclosed spaces, removing fine dust, VOCs, and CO₂ while supplying oxygen.

Summary

The Circulation and Purification Module exemplifies the integration of biomimetic design, fluid dynamics, and filtration technologies to maintain homeostasis, whether in biological systems, environmental management, or engineered spaces. Its highlights include continuous circulation, efficient contaminant removal, sustainability, and adaptability across air, water, and blood purification applications.

Article Content

Principles of Extracorporeal Circulation and Transport Phenomena ...

During renal replacement therapy, blood circulates through an extracorporeal circuit, in which the site of purification is a filter. This chapter describes first the main components of the extracorporeal circuit

Plasmapher Apherlungs

The PURIFICATION Module arises from the ability to utilize apheresis techniques in complex clinical scenarios, such as severe heart and/or respiratory failure, which require the use of extracorporeal

What is Closed-Loop Nitrogen Circulation in Powder Processing

Closed-loop nitrogen circulation is a fully sealed recycled inert gas system for powder production lines. It circulates and reuses nitrogen inside the whole process pipeline instead of

Concept of circulatory/respiratory air purification system (CAPS). a ...

The circulatory and respiratory systems in humans are marvels of biological engineering that exhibit competence in maintaining homeostasis.

Circulation systems for the purification of waste water

MODO is a washroom facility which is self-sufficient in terms of both energy and water. It produces its own energy and cleans polluted water in a container, making it available for reuse. The wastewater

Lungs: Purification & Gas Exchange Process

Cilia and mucus in the respiratory system play a critical role in air purification by trapping dust, dirt, and bacteria, preventing these harmful substances from entering the lungs.

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In this study, a novel multi-stage circulation (MSC) CO₂ absorption process was proposed, which implemented independent regulation of each stage, resulting in enhanced CO₂

Extracorporeal Blood Purification in Sepsis and Septic Shock

We acknowledge the fact that sepsis and septic shock are induced, sustained and perpetuated with the help of circulating molecules released from various activated inflammatory cells.

Human Circulatory/Respiratory-Inspired Comprehensive Air

A biomimetic approach, composed of a microbubble-based gas exchanger and circulating liquid inspired by alveoli, capillary beds, and bloodstream of the human

Innovative design, fabrication, and evaluation of an integrated smart ...

Innovative design, fabrication, and evaluation of an integrated smart green facade and photovoltaic: A double-layer air circulation system for air retention time exposure to plants and PV

Study on Water Purification Effect and Operation Parameters of

The discharge of wastewater from aquaculture ponds causes a certain degree of damage to the environment. It is necessary to continuously improve the treatment efficiency of

Overview of the recovery and purification of hydrogen isotopes in ...

The design of Pd-based membrane modules must consider the interaction of hydrogen with metal, mass transfer mechanisms of hydrogen through metals and associated isotopic effects

Progress in wastewater treatment, separation and purification ...

These innovations highlight the adaptability, efficiency, and sustainability of hydrocyclone systems, reinforcing their role as a cost-effective and reliable solution in modern wastewater

Digitally programmable microfluidic valving for autonomous, high ...

In contrast to existing microfluidic valves, rotary valves, or automated chromatography modules that primarily automate flow routing, the ICV-CCV architecture embeds purification rules

The running modes and building application performance on a solar

Thus, the scalable solar-based thermal catalytic purification module (TCPM), as an integrated module, holds significant potential for passive solar building systems like the T-wall.

Solar-driven water purification technologies

Solar-based purification systems offer an alternative, yet it requires ongoing advancements in materials, design, and integration to meet real-world demands. For solar water

Digital design of an integrated purification system for continuous ...

The uncertain parameters of the flowsheet model of the integrated purification step for paracetamol are summarized in Table 3. While the uncertainties coming from connection with

Understanding the Purified Water System: A Detailed Diagram

The purified water is then passed through the purification system, which typically consists of technologies such as reverse osmosis, ion exchange, and ultraviolet (UV) disinfection. These

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