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APPLICATION NOTE

Use of Armored RNA in Wastewater and Environmental Water Testing

Wastewater testing plays a vital role in early disease detection, comprehensive community health assessment, and environmental monitoring making it a valuable tool for proactive public health and environmental management.

Early Warning for Disease Outbreaks

Virus detection: Wastewater can contain traces of viruses, bacteria, and parasites shed by infected individuals, even if they're asymptomatic. This allows for early detection of disease outbreaks, like COVID-19, before widespread clinical diagnoses occur. This crucial lead time can inform proactive public health measures, like targeted testing and interventions.

Public Health Monitoring

Community health assessment: By analyzing the prevalence of various pathogens and chemicals in wastewater, we can gain a broader understanding of a community's overall health. This information can be used to track trends, identify populations at risk, and optimize resource allocation for preventive healthcare programs.

Environmental Protection

Water quality monitoring: Wastewater testing helps assess the effectiveness of treatment plants and identify potential contamination sources. This is essential for ensuring the quality of treated water discharged into rivers, lakes, and other environmental resources.

Efficiency and Cost-Effectiveness

Large-scale monitoring: Compared to individual testing, wastewater testing provides a cost-effective way to monitor the health and environmental well-being of a large population. This is particularly advantageous in resource-constrained settings.

Non-invasive approach: Wastewater testing doesn't require individual participation, making it particularly valuable for reaching asymptomatic individuals, marginalized communities, and those hesitant to engage in traditional testing methods.

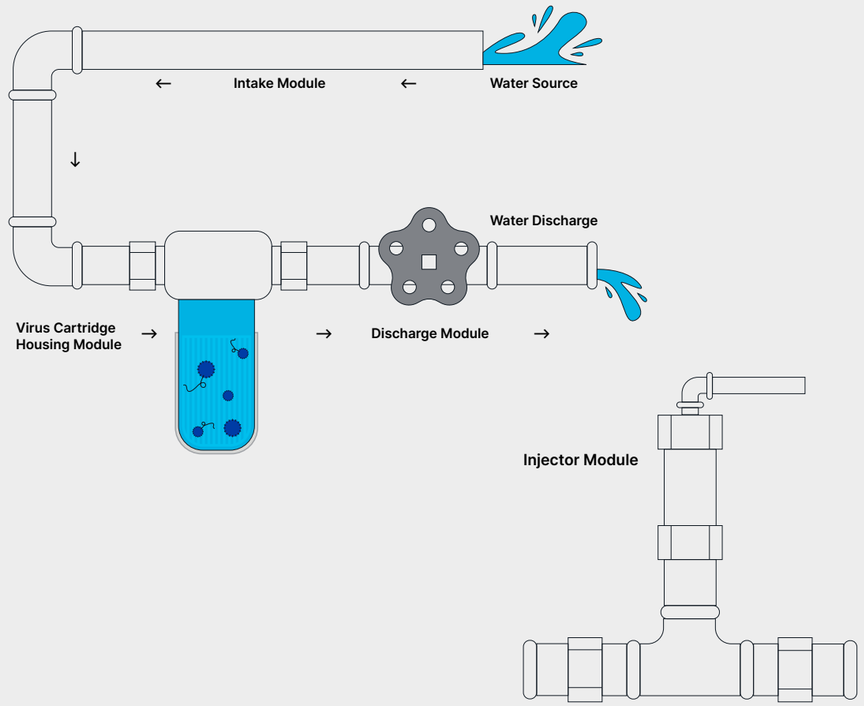

Figure 1: Sample filtration approach for pathogen detection in wastewater testing

Armored RNA can be used in wastewater testing as a control for the detection and quantification of RNA, including SARS-CoV-2 RNA. It is used to monitor the efficiency of RNA extraction and to detect any inhibition in the reverse transcription-polymerase chain reaction (RT-PCR) process.

Positive Control: The use of **Armored RNA** as an internal positive control in wastewater testing is described in studies that monitor SARS-CoV-2 RNA in influent and effluent wastewater samples with different concentration methods [1].

Full Process Control: Armored RNA is added to the samples to monitor the recovery efficiency of the RNA extraction methods, and it is particularly useful for detecting viral pathogens in wastewater samples, such as SARS-CoV-2 [1][2].

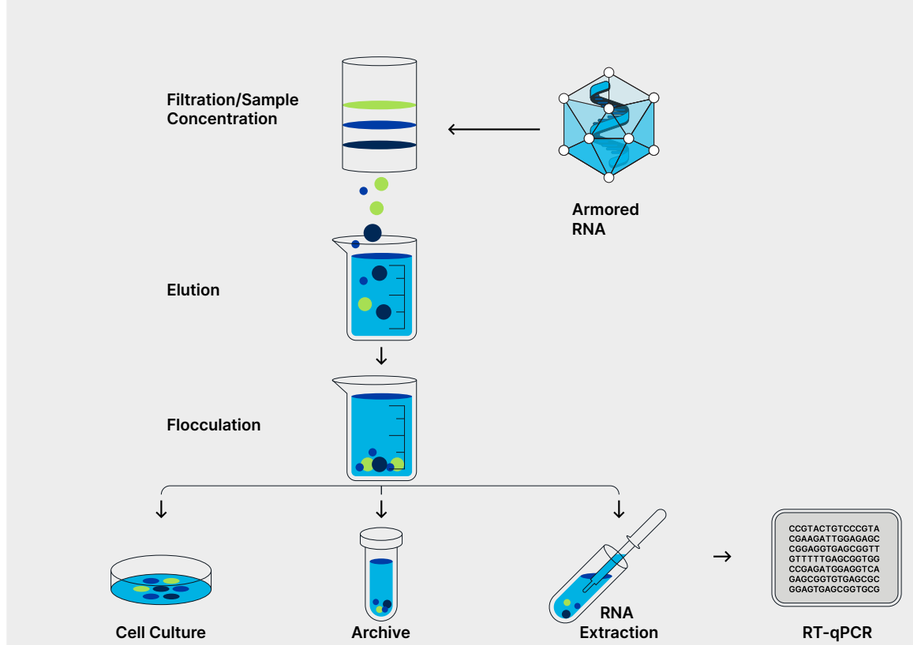

Figure 2: Armored RNA as a spike-in full process control to monitor recovery efficiency of the RNA extraction methods.

Armored RNA has various applications in the field of environmental water testing beyond infectious disease detection. Some of these applications include:

Control for Environmental Testing: Armored RNA can be used as a standard to construct a calibration curve for real-time reverse transcription-polymerase chain reaction (RT-PCR) in environmental testing, such as the standardization of a real-time RT-PCR for environmental testing of enterovirus RNA [3].

Monitoring Gene Expression in Environmental Samples: Armored RNA standards have been used to measure gene expression in environmental samples. For example, a study developed a durable and ribonuclease-resistant armored RNA standard to measure microcystin synthetase E gene expression in toxic Microcystis sp. [4].

Inhibition Control in Water Testing: Armored RNA products have been used as inhibition controls in water testing. For instance, Method 1615 for the detection of enteric viruses from environmental waters includes the use of Armored RNA Quant® EPA-1615 as a positive reference and Armored RNA® HGV product as an inhibition control [5].

The advantages of using Armored RNA in wastewater and environmental testing include:

Protection from Degradation: Armored RNA is resistant to degradation by ribonucleases, making it more stable and reliable than naked RNA controls. This property is particularly beneficial in environmental testing, where samples may contain ribonucleases that can degrade unprotected RNA [2].

Improved Reliability: The use of Armored RNA enhances the reliability of diagnostic assays by reducing the risk of contamination and degradation. In contrast, naked RNA controls are more susceptible to contamination and degradation, which can lead to erroneous results and assay failures.

Ease of Use and Standardization: Armored RNA is easier to manufacture, more stable, and less hazardous than certain viruses, such as HCV. It can be used directly as a quantitative standard, simplifying the assay process and reducing the risk of errors associated with RNA extraction.

Versatility: Armored RNA can be used for applications beyond infectious disease detection, such as monitoring gene expression and assessing sample extraction efficiency in environmental testing.

Cost-Effectiveness: Armored RNA can be shipped at ambient temperatures, reducing the cost compared to those associated with dry-ice shipments. This makes it a cost-effective option for environmental testing in resource-limited settings.

These applications demonstrate the versatility of Armored RNA in wastewater and environmental testing, ranging from standardization of RT-PCR to monitoring gene expression and assessing sample extraction efficiency. Armored RNA offers unique advantages such as protection from degradation, improved reliability, ease of use, versatility, and cost-effectiveness, making it a valuable tool for various applications in this field.

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