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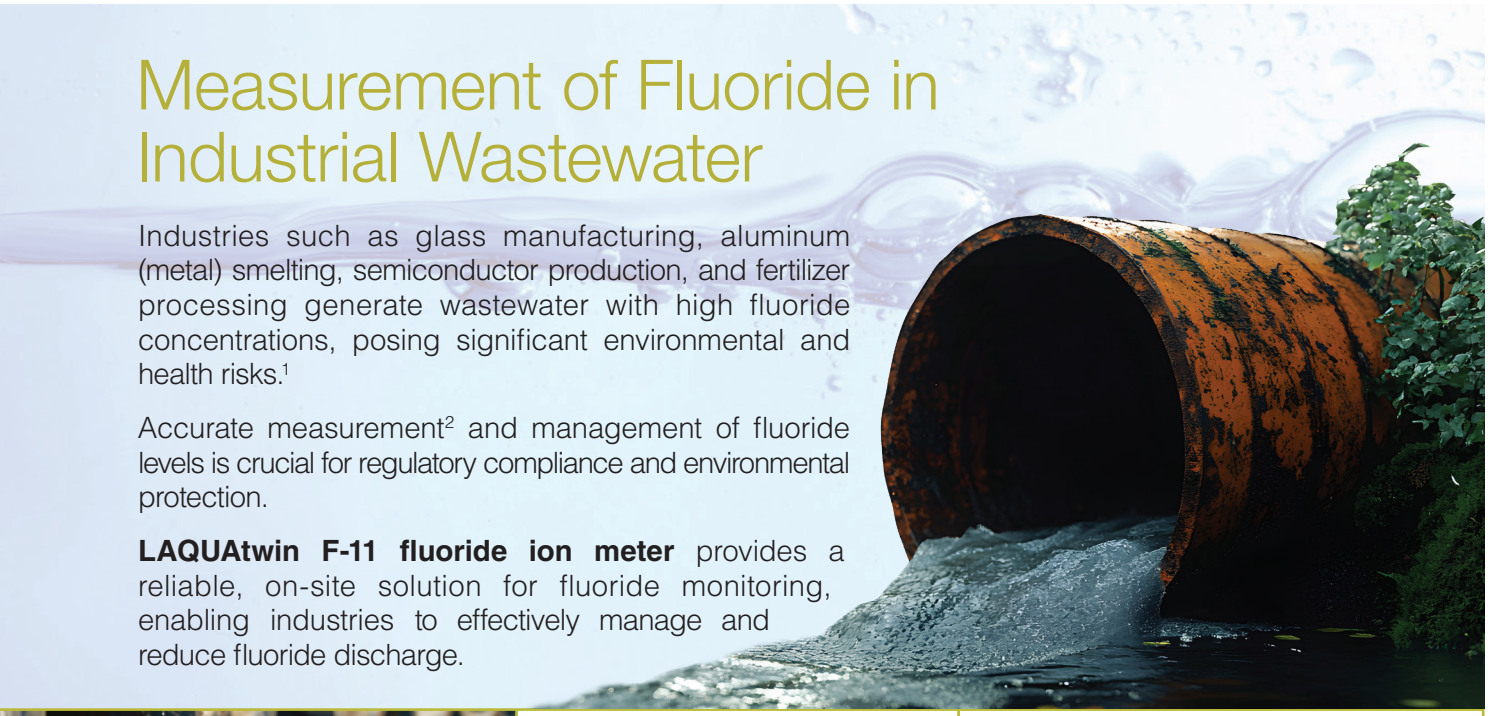
LAQUAtwin F

Application Note

01-2025

Measurement of Fluoride in Industrial Wastewater



Industries such as glass manufacturing, aluminum (metal) smelting, semiconductor production, and fertilizer processing generate wastewater with high fluoride concentrations, posing significant environmental and health risks.[1]

Accurate measurement[2] and management of fluoride levels is crucial for regulatory compliance and environmental protection.

LAQUAtwin F-11 fluoride ion meter provides a reliable, on-site solution for fluoride monitoring, enabling industries to effectively manage and reduce fluoride discharge.

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LAQUAtwin F-11 Product Page

Introduction

Fluoride contamination in industrial wastewater is a significant environmental issue. Industries such as glass manufacturing, aluminium smelting, semiconductor production, and fertilizer processing generate wastewater with high fluoride concentrations. Fluoride, used in these industries can lead to effluents[3] containing harmful levels of fluoride if not properly managed.

Excessive fluoride in the environment can cause severe health issues[4], including dental and skeletal fluorosis which results in tooth discoloration, enamel damage, and bone deformities. High fluoride exposure may also affect the urinary, renal, endocrine, brain, and reproductive systems.

To meet regulatory standards and mitigate these risks, industries use treatment methods such as adsorption using activated alumina or bone char, membrane processes like reverse osmosis and nanofiltration, chemical precipitation with calcium salts, and electrocoagulation.

Accurate measurement and management of fluoride levels are essential to ensure compliance with environmental regulations and for the protection of public health.

The **LAQUAtwin F-11 fluoride ion meter** offers a convenient and reliable solution for on-site fluoride measurement, enabling industries to monitor and manage fluoride levels effectively. The meter analyses as little as 0.3ml sample and delivers accurate

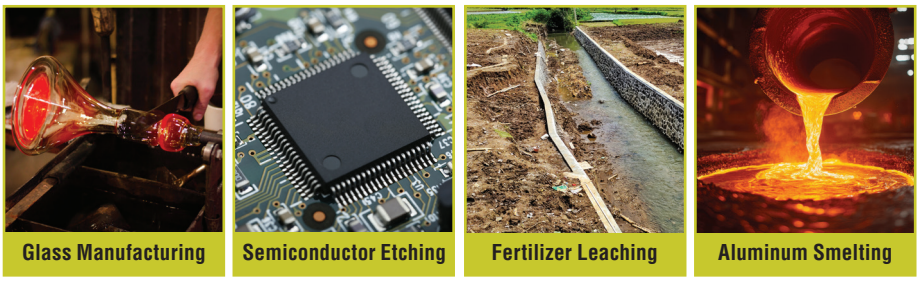

Figure 1: Industries with High Fluoride Wastewater

Table 1: Industries with High Fluoride Wastewater

Glass Manufacturing	Industry uses fluorinated compound (AlF_3) to help improve properties of glass, introducing fluoride into wastewater during production processes.[5]
Aluminium Production	Fluoride is used in the form of cryolite ($NaFAlF_3$) in the electrolytic reduction of alumina to aluminium[6], leading to significant fluoride emissions in wastewater.
Fertilizer Plants	Phosphate fertilizers contain fluoride[7], which can leach into wastewater during production and application.
Semiconductor Etching	Etching process use fluoride-containing chemicals[8] (HF) to create intricate patterns on silicon wafers. Process generates wastewater with high fluoride concentrations.

Table 2[9]: Methods for Fluoride Removal

Adsorption	**Activated Alumina** is used to adsorb fluoride ions in water. **Bone Charcoal**: Charred animal bones are used as catalyst to adsorb fluoride.
Membrane Processes	**Reverse Osmosis (RO)**: The membranes effectively remove ions from wastewater by forcing water through a semi-permeable membrane, leaving fluoride ions behind. **Nanofiltration**: Similar to RO, nanofiltration membranes can selectively remove fluoride ions from water.
Chemical Precipitation	**Calcium Salts**: Adding calcium salts (calcium chloride) to wastewater can precipitate fluoride as calcium fluoride (CaF_2), which can then be removed by sedimentation or filtration.
Electrocoagulation	Electrical current is used to coagulate and remove fluoride from wastewater.

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result in seconds. This rapid test enables industries to adjust their wastewater treatment systems promptly, ensuring compliance with local regulatory discharge limits.

Many countries have stringent environmental regulations that require the industries to ensure that the fluoride concentration in their discharge does not exceed specific limits. Exceeding these limits can result in significant fines and environmental repercussions.

Refer to Table 3 for Fluoride Effluent Limit of Some Countries.

Method

Sample Preparation

Collect a minimum sample (1 ml) of the effluent in the 5ml plastic beaker. Refer to the table below.

Type of Sample	Does the sample contain Fe^{3+}, Al^{3+}, Si^{4+} or highly concentrated ions?	
	Yes	No
Two-Point Calibration	1. Add 1 mL of TISAB & 1 mL of 1ppm standard solution. Shake to mix it. 2. Repeat above step but with 10ppm standard solution instead.	Calibrate with 1ppm and 10ppm standard solutions.
Measurement	Add 1mL of TISAB & 1mL of sample and measure.	Measure sample directly.

Calibration

Calibrate the meter with the 1ppm and 10ppm standard solutions provided to ensure accuracy.

Measurement

Place a few drops of the sample on the sensor and wait for a stabilized reading, which will be indicated by ☺.

Recording Results

Record the measurement for compliance and reporting purposes.

Results And Benefits

Using the **LAQUAtwin F-11 fluoride ion meter** provides several benefits:

- **Immediate Results:** Obtain fluoride concentration readings onsite without delays, enabling prompt decision-making.
- **Compliance Assurance:** Ensure that effluent discharge meets regulatory standards, avoiding fines and environmental penalties.
- **Portability:** The compact and portable design of the meter allows easy on-site testing, making it convenient for use in various locations within the facility.

By implementing the **LAQUAtwin F-11 fluoride ion meter**, companies can efficiently manage their fluoride discharge, ensuring compliance with environmental standards and avoiding potential fines.

Table 3: Fluoride Effluent Limit of Some Countries

Country	Fluoride Effluent Limit (ppm / mg/L)
Singapore	**15.0**[10]
Malaysia	**2.0 (Standard A*), 5.0 (Standard B**)**[11] *Any inland waters within catchment areas. **Any other inland waters or Malaysian waters.
India	Fluoride in effluent is 2.0 mg/L for inland surface water and 15 mg/L for marine coastal areas[12]

Standard A: This standard applies to the discharge of effluents into any inland waters within catchment areas. The limits are stricter to protect sensitive water bodies and ecosystems.

Standard B: This standard applies to the discharge of effluents into any other inland waters or Malaysian waters. The limits are less stringent compared to Standard A.

References And Suggested Readings

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