Importance of first response learned from water leak trouble in vacuum

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1. Introduction

Background and Purpose

A terrible water leakage occured in the vacuum chamber of an ECR ion source. When the leakage occured, a quadrupole mass spectrometer(QMS) installed on the ECR ion source showed partial pressure increases for M=16, 17, 18(water), 14, 28, and 32(air), as shown in Fig.1. From the signal of the QMS, we initially thought that air flowed into the vacuum chamber due to a kind of vacuum leakage. We later noticed that it was caused by a water leakage, not by the air leakage. Due to the wrong judgment, severe damages spread to entire system of the vacuum system of the ion source. To restore the vacuum system and restart the ion source, we spent three weeks. In order to prevent the same failure, we consider a method to quickly recognize the water leakage.

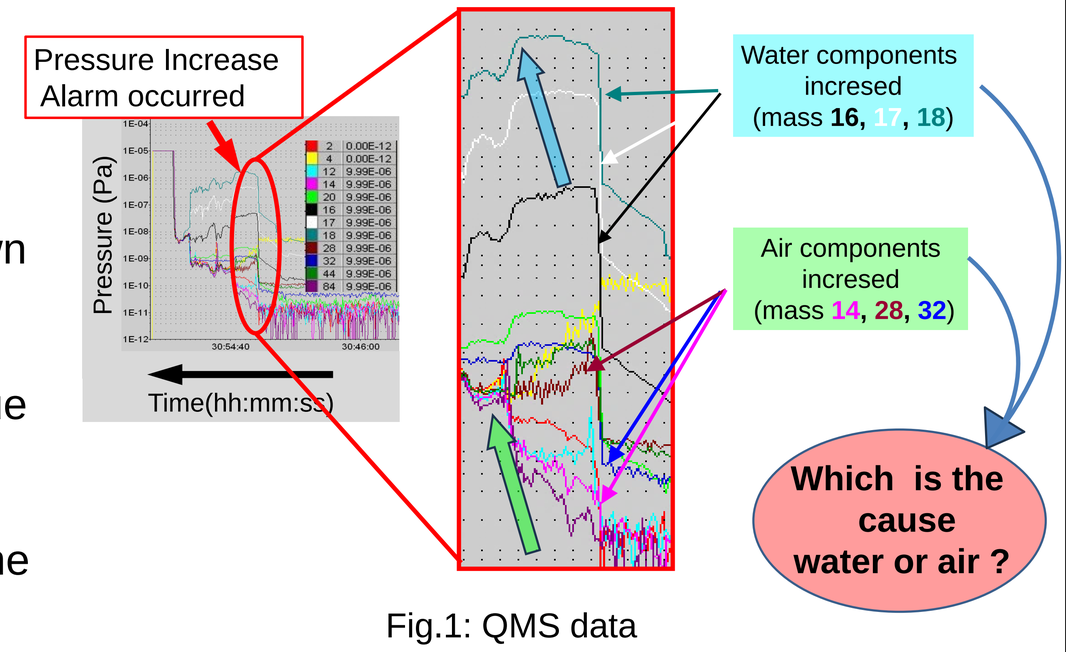
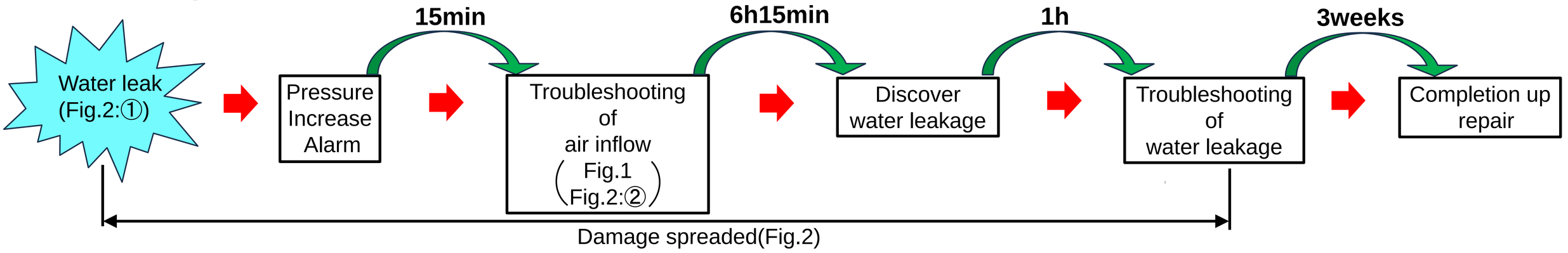
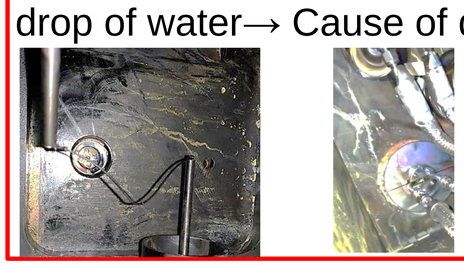


Fig.1: QMS data

2. Background of water leak trouble in vacuum



Downstream vacuum chamber
drop of water→ Cause of discharge

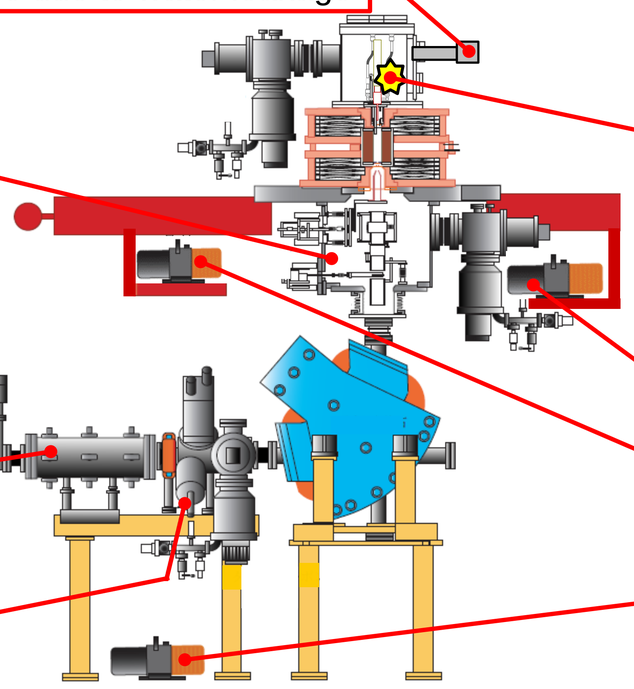


Triple quadrupole electrode
Insulation breakdown due to water droplets
→ Blow dry

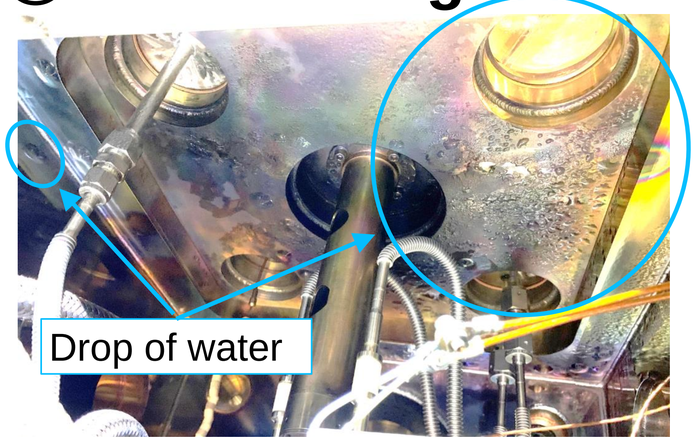
FAN

Faraday cup
Insulation breakdown due to water droplets

②QMS
Failure due to water leakage



①Water leakage



Oil rotary vacuum pump
Water in oil → Can't pull a vacuum

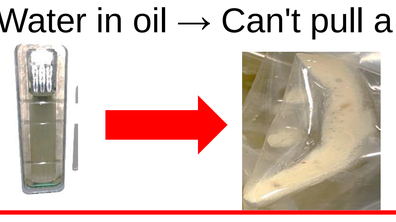


Fig.2: Damage Situation

3. Lesson

・If the QMS had been able to determine that the cause of the pressure increase was a water leakage, the repair time could have been reduced from three weeks to one week.

・We are considering developing a system that can introduce water and air separately into the test chamber, conduct water and air separation tests, and quantitatively evaluate differences by accumulated QMS data in order to distinguish water from air(Fig. 3).

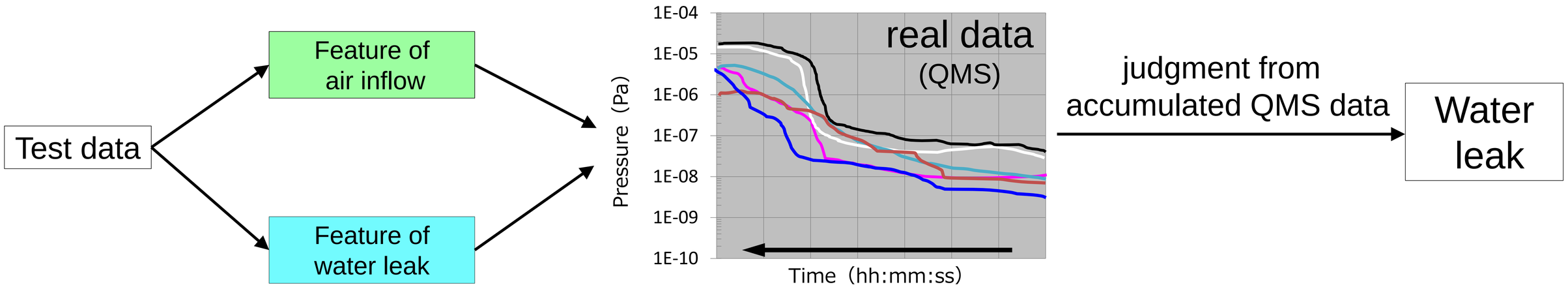


Fig.3: Water leak detection method using a QMS

4. Summary

・Water leakage occurred in the vacuum chamber.
・It took three weeks to recover from the damage caused by misjudgment in the first response.
・Develop a method to detect water leakage using a QMS in the test chamber.