White paper

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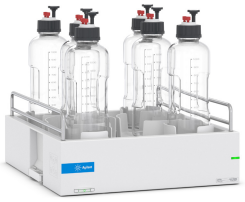
HPLC Solvent Management with Confidence and Ease – Agilent InfinityLab Level Sensing



Abstract

Agilent InfinityLab Level Sensing, part of the Agilent Infinity III LC Series, offers HPLC and UHPLC solvent management with confidence and ease. This white paper describes how the InfinityLab Level Sensing, together with the Solvent Monitor and Solvent Prediction in Agilent OpenLab CDS help to accurately track HPLC solvent levels, prevent the LC from running dry, and ensure that sufficient solvent is available for planned sequences to complete successfully.

Introduction

The Agilent Infinity III LC Series provides scientists with advanced technology to stay connected and automate daily HPLC routines. Agilent InfinityLab Level Sensing accurately monitors solvent levels, ensuring optimal productivity while preventing the pump from running out of mobile phase. This prevents HPLC instrument or column damage as well as time-consuming re-analysis, thereby saving costs and increasing confidence. The Solvent Monitor offers a real-time display of solvent levels and warns the user in time before limits are reached. Furthermore, refilling of solvents is automatically recognized, eliminating the need to manually adjust the replenished solvent volume in the software, which avoids errors.

Solvent Prediction is offered in Agilent OpenLab CDS. This feature estimates the HPLC solvent consumption for a complete sequence and warns the user before the sequence is started, so that the analyses complete successfully. InfinityLab Level Sensing can be installed onto any InfinityLab LC system* by replacing the solvent cabinet with the Level Sensing unit. This white paper describes how solvent management for any LC system benefits from InfinityLab Level Sensing.

Solvent management with InfinityLab Level Sensing

Connection to the LC instrument

InfinityLab Level Sensing (G7175A) is easily installed as an upgrade to the Agilent 1260 Infinity II LC, Agilent 1260 Infinity III LC, Agilent 1290 Infinity II LC, and Agilent 1290 Infinity III LC systems, replacing the solvent cabinet as the topmost module. It possesses its own power supply and status LED and is connected to the other modules by a controller area network connection.

InfinityLab Level Sensing is compatible with Agilent OpenLab CDS, version 2.8 update 07 or higher. Firmware and driver requirements are minimum driver version 3.9 and minimum firmware version 7.42 for the pump. Control using the Agilent InfinityLab Assist (G7180A) is supported with firmware D.07.42 or above.

Technical principle

InfinityLab Level Sensing is based on weight measurement of the solvent bottles using balances built into the Level Sensing unit. It features differential measurement of the bottle weight so that no bottle tare weight is necessary. When solvent is consumed by the pump flow, the weight loss and the (known) pumped volume are evaluated. The reduced solvent volume is calculated and displayed in the Solvent Monitor.

The presence of a solvent bottle on a bottle plate is automatically recognized. The minimum load for solvent bottle recognition is 50 grams and the maximum load per bottle plate is 5 kilograms. A hard stop for the load cells prevents overload, and sealing avoids damage due to liquid spilling from the solvent bottles.

It is important to note that the balances built into Level Sensing do not impact analytical results, which means that InfinityLab Level Sensing is not a calibrated measuring equipment.

Design of InfinityLab Level Sensing

InfinityLab Level Sensing (see Figure 1) features weight-controlled solvent level sensing for up to six bottles containing HPLC solvents. Solvent bottles with a volume between 0.125 L and 2.5 L are supported. Four bottle plates are available for up to 1 L volume bottles (maximum bottle diameter of 100 mm) and two bottle plates can hold bottles up to 2.5 L volume (maximum bottle diameter of 150 mm). Additionally, two more 1 L volume bottles that do not need solvent level sensing can be placed between the bottle plates without interfering with the level sensing positions.

For customers requiring solvent level sensing for up to 12 bottles, e.g. for method development, two InfinityLab Level Sensing units can be installed.

Figure 1. Agilent InfinityLab Level Sensing.

Solvent tube guides, which attach the solvent tubing to the rail of the Level Sensing, ensure that the pathway of solvent tubing does not interfere with the weight determination and enable a tidy appearance of the LC's solvent supply.

* Agilent InfinityLab Level Sensing is compatible with Agilent 1260 Infinity II LC, Agilent 1260 Infinity III LC, Agilent 1290 Infinity II LC, and Agilent 1290 Infinity III LC systems.

Working with InfinityLab Level Sensing

Settings of InfinityLab Level Sensing are available in the pump menu and can be accessed by a right click on the pump tile in the Instrument Status screen. Display of the Solvent Monitor can be selected through the OpenLab CDS ribbon tab.

Zero of the bottle positions: After installation of the Level Sensing, a zero of the bottle positions is performed (see Figure 2). The bottle positions are named L1-L3 from front to back on the left side, and R1-R3 from front to back on the right side. The bottle positions can either be zeroed individually, or all positions can be selected.

Level Sensing assignment: The filled solvent bottle is placed on the bottle position and level sensing assignment is performed (see Figure 3). During level sensing assignment, for every used bottle position, the user needs to specify the connected channel (e.g. pump channel A), the bottle volume, and the actual solvent volume contained in the bottle. Furthermore, the solvent name can be entered for information purposes.

Definition of limits: In the level sensing assignment dialog, limits are defined. For each assigned position, individual limits can be defined based on the bottle volume used. If the solvent level reaches the Not Ready limit (Prevent analysis if level falls below), a run that is in progress will be completed, but no further run is started, and the pump will be converted to the Not Ready condition. If the solvent level reaches the Error limit (Turn off pump if running out of solvent), the pump will be converted to the Error condition and will be turned off to prevent the LC from running dry.

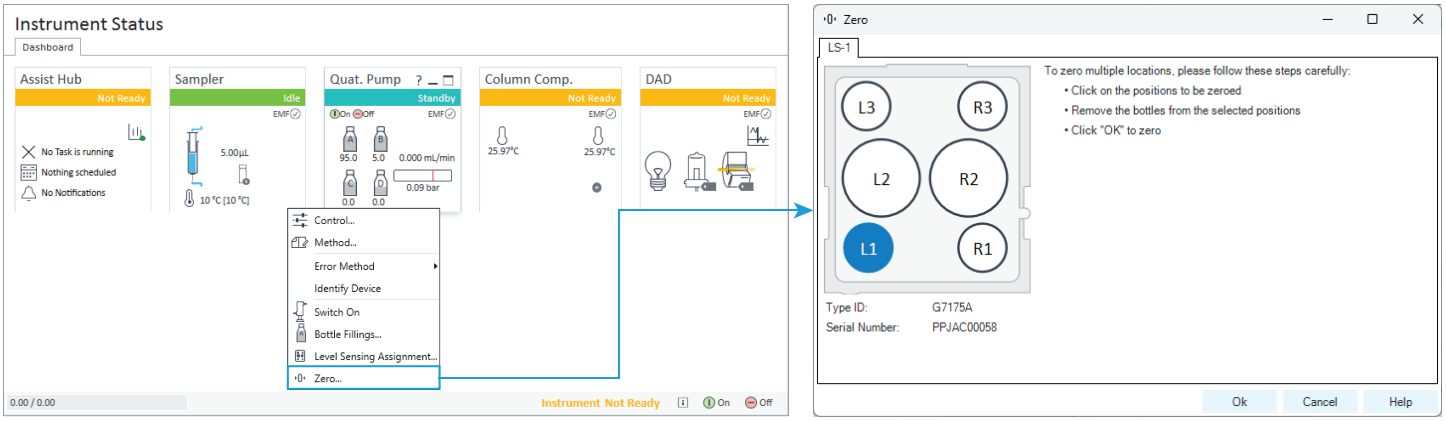


Figure 2. Zero of the bottle positions.

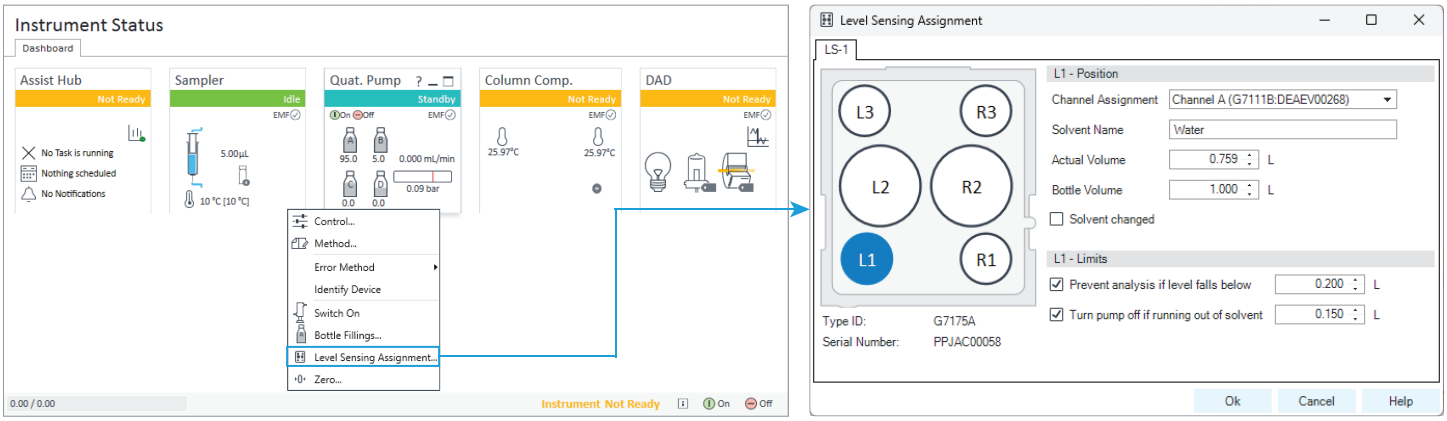


Figure 3. Level Sensing assignment.

Refilling and changing solvents: When refilling an empty solvent bottle with fresh solvent, the replenishment is automatically recognized by the weight increase. The user does not need to update the actual solvent volume, as the replenished solvent volume is automatically determined.

When an empty solvent bottle is exchanged, the user should specify the bottle volume, and the actual solvent volume contained in the new bottle to refresh the differential measurement of the bottle weight.

Once the type of solvent is changed, e.g. from acetonitrile to methanol, the user needs to perform a solvent change to enable a correct calculation of the reduced solvent volume from the weight loss and the (known) pumped volume during operation. In the level sensing assignment dialog, the Solvent Change check box should be selected and a new assignment of the bottle volume and the actual solvent volume contained in the bottle is required (see Figure 4).

Solvent Monitor: The Solvent Monitor (see Figure 5) shows the user real-time solvent level information for all assigned positions at a single glance. For each assigned position, the actual solvent volume, the solvent name, and the bottle position on the Level Sensing are displayed. Furthermore, a consumption estimate for the active run queue (see Solvent Prediction) as well as an estimation of the leftover volume is shown. A visualization of the solvent bottle shows the total bottle volume and the actual fill state. The Not Ready limit is displayed by a red line. Solvent consumed during the active run queue is visualized with increased color transparency. When the estimated leftover volume gets close to the Not Ready limit, a solvent refill prompt is shown in time for the user to refill the affected solvent.

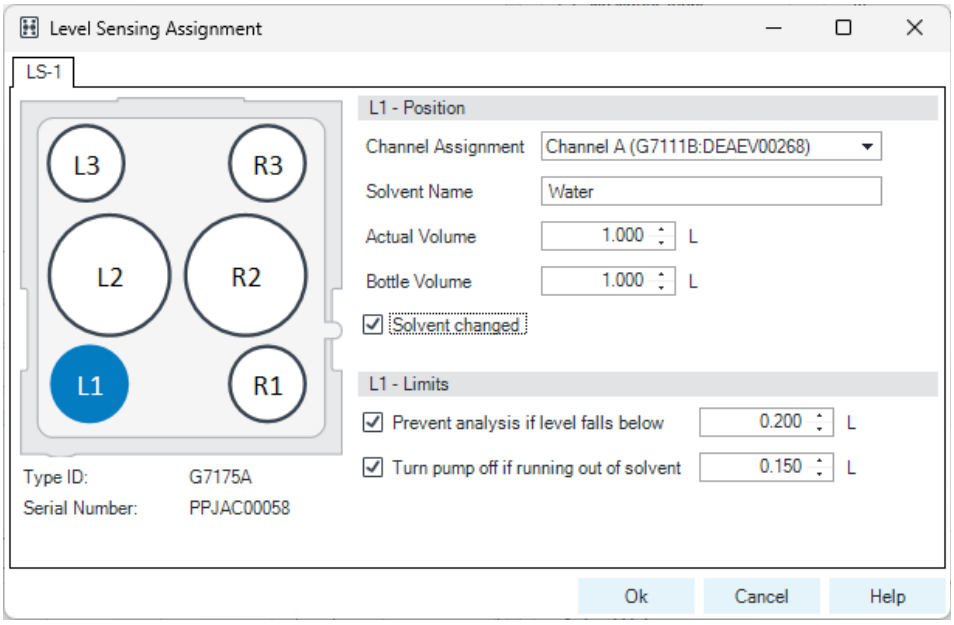


Figure 4. Solvent change.

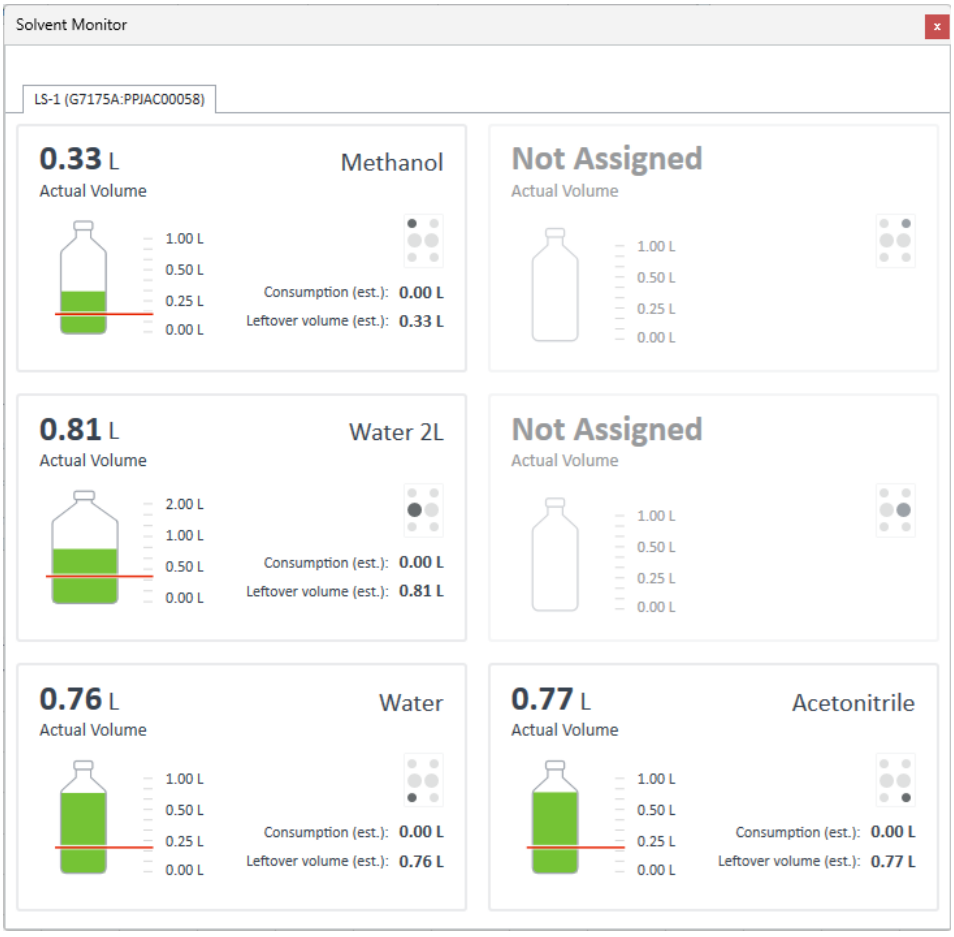


Figure 5. Solvent Monitor.

Solvent Prediction in OpenLab CDS

In OpenLab CDS, Solvent Prediction is available as part of sequence validation to predict the HPLC solvent consumption for a planned sequence. After setting up the sequence, sequence validation is performed by clicking Validate. Solvent consumption estimates (see Figure 6) can be viewed in the verification details.

The estimated solvent consumption includes solvent required for the analysis, including post time, as well as the solvent used during overhead time, e.g. drawing the sample between two runs of a sequence. Special cases, such as wait times due to changes of the column compartment temperature or the injector program are currently not taken into account for Solvent Prediction.

In the solvent consumption estimation (Figure 6), the actual volume of solvent contained in the respective solvent bottle and the consumption estimate of the active run queue are taken into account. With the consumption estimate of the planned sequence, whether or not there is sufficient solvent available for executing the planned sequence is calculated. If the estimated leftover volume of a solvent falls below the Not Ready limit, a caution message is displayed. The user may decide to start the sequence even if a caution message is displayed.

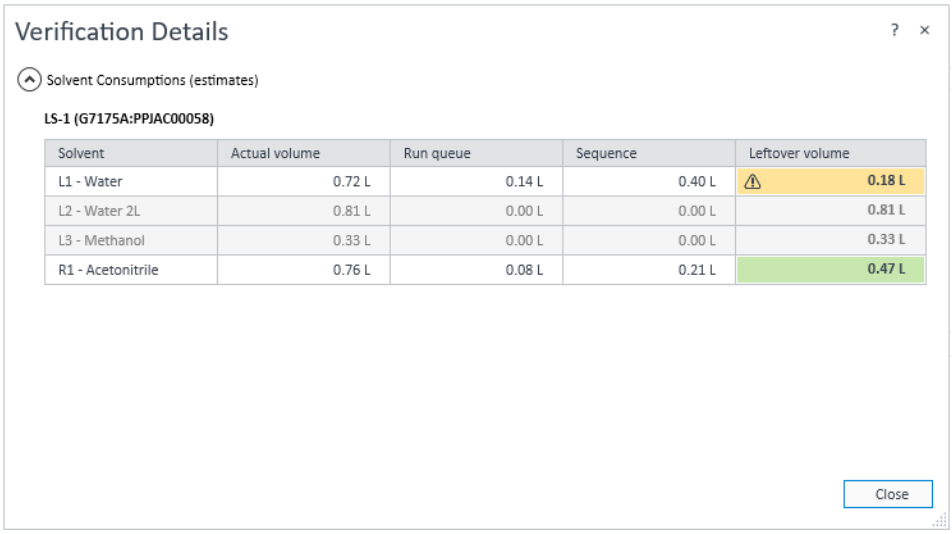


Figure 6. Solvent prediction as part of sequence validation.

As soon as the estimated leftover volume of the active run queue falls below the Not Ready limit for a solvent, this solvent is highlighted in yellow in the Solvent Monitor, and a caution message and prompt to refill the solvent is displayed (see Figure 7). The caution message is also displayed at the respective position in the run queue (see Figure 8). When the estimated leftover volume falls below the error limit for a solvent, it is highlighted in red with the respective refill prompt (see Figure 7).

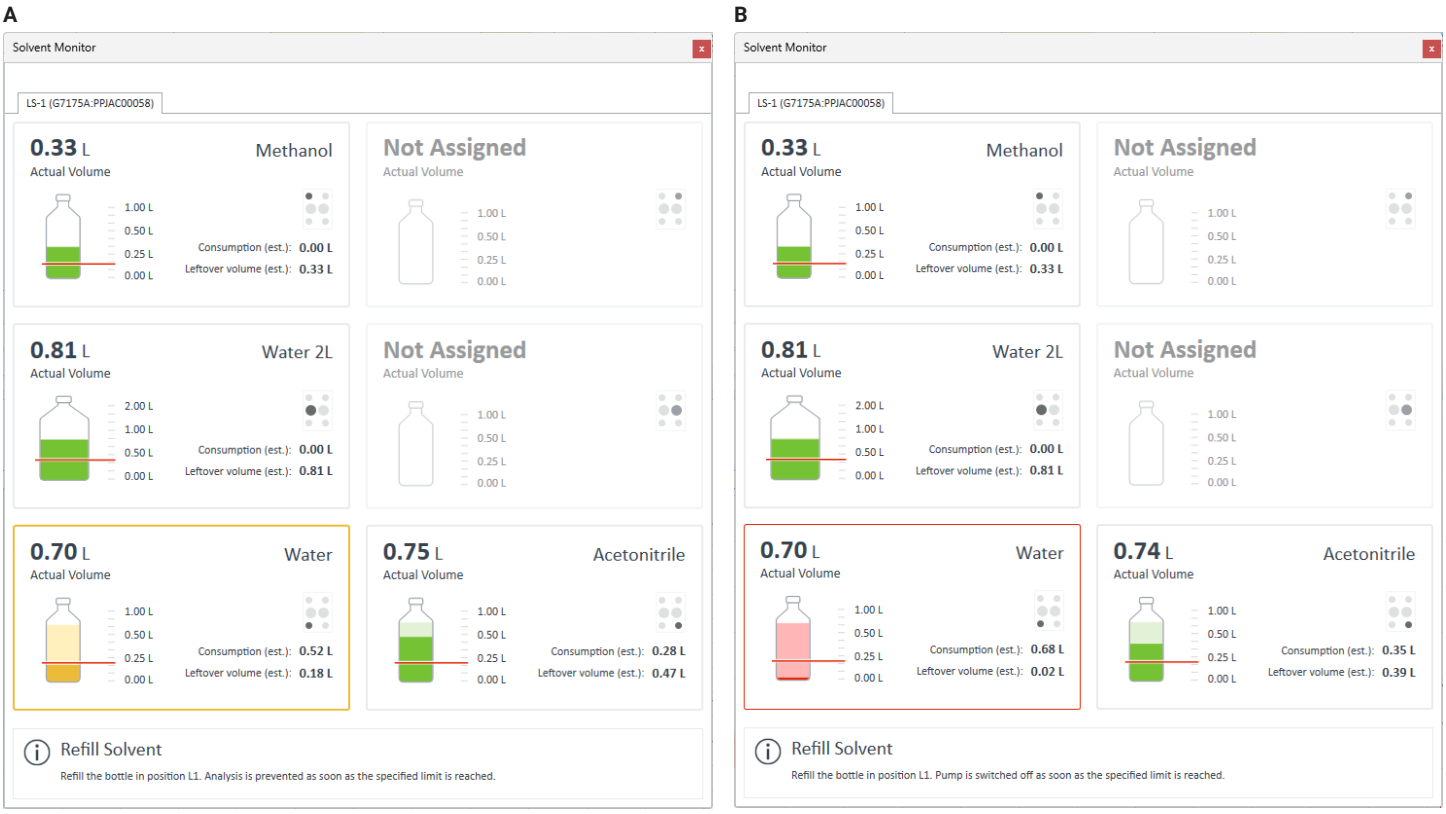


Figure 7. Solvent Monitor showing the prompt to refill a solvent when the leftover volume reaches the not ready (A) or error limit (B).

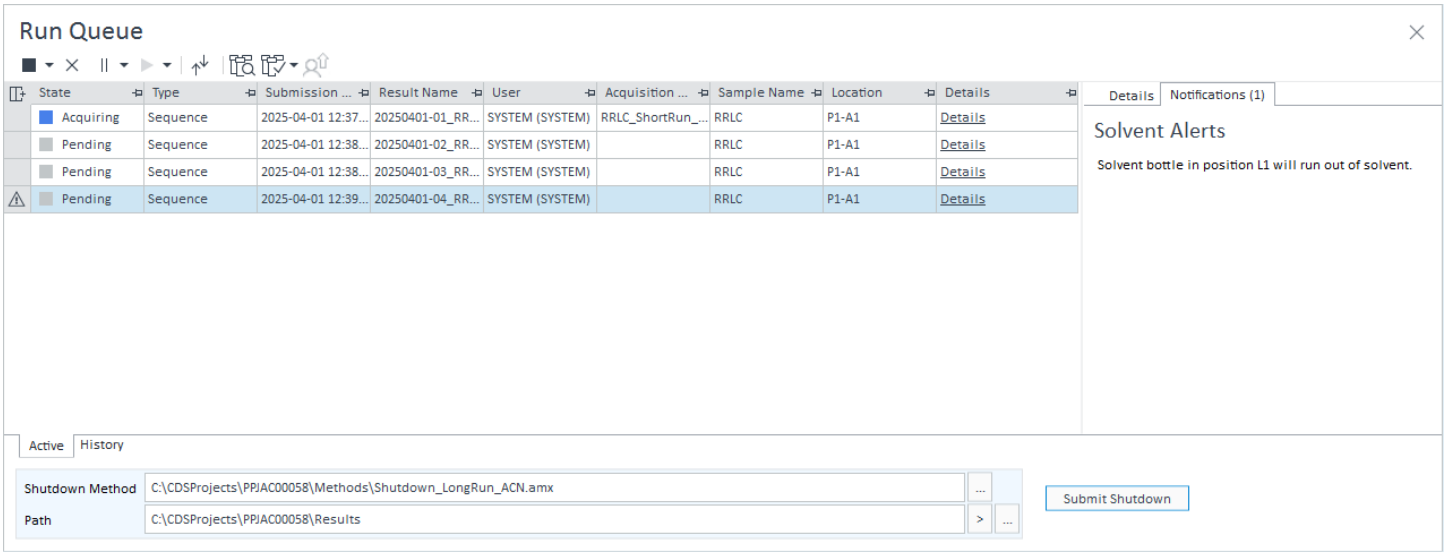


Figure 8. Solvent alert shown in the run queue.

Conclusion

Agilent InfinityLab Level Sensing with the Solvent Monitor and Solvent Prediction in Agilent OpenLab CDS offers HPLC solvent management with confidence and ease for any Agilent Infinity II or III LC system. The user can be assured that planned analyses complete successfully and that the mobile phase will not run dry, increasing confidence and avoiding costs caused by failed analyses.

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