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Technical Report

Use of Solvent Delivery Unit Equipped with Auto-diagnostics and Auto-recovery Functions to Enhance Lab Productivity

- Analytical Intelligence Part 1 -

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Abstract:

In order to improve productivity in modern analysis laboratories, it is essential to reduce analysis time and maximize throughput through regular maintenance. One issue to be resolved is the interruption of analysis due to unforeseeable problems. An example of this is air bubbles in the flow line, which can cause shifts in retention times, pulsating baselines, unexpected changes in peak shapes. In this report, we describe the effectiveness of auto-diagnostics and auto-recovery functions in detecting and resolving this problem automatically. These functions minimize system downtime due to air bubbles and contribute to the optimization of laboratory productivity.

Keywords: Auto-diagnostics, Auto-recovery, Nexera™ solvent delivery unit

1. Bubble Formation in Flow Lines

The amount of gas that a liquid can absorb depends on several factors, such as the pressure and temperature gradients, and the nature and type of the liquid and gas (see reference).

Gas bubbles are produced in a liquid when the amount of dissolved gas in a solution exceeds the saturated solubility (supersaturation). Usually, the bubbles are removed through the degassing unit. However, in rare cases, they can appear in the flow line of an HPLC / UHPLC and reach the pump. These bubbles can cause shifts in retention times, pulsating baselines, unexpected changes in peak areas, irregular peak shapes.

This can dramatically affect the analytical results due to inaccuracies, poor precision, or inability to distinguish between trace amounts of analytes and the baseline. It also prevents the identification of analytes that are close to their detection limits.

2. Auto-diagnostics and Auto-recovery

Air bubbles can appear in HPLC/UHPLC systems when air has not been removed from the mobile phase, when room temperature varies dramatically or surfactants are added to mobile phase.

When air bubbles are encountered, they require the presence of an operator to be dealt with. The operator will usually remove bubbles by stopping the analysis in progress and purging the flow lines.

When the instrument is running unattended (e.g. at night), undetected air bubbles within flowlines can affect a large number of analysis samples, resulting in data loss and time-consuming re-runs.

Auto-diagnostics and auto-recovery functions prevent data loss and waste of samples by automatically detecting abnormal pressure variations triggered by air bubbles within the system and performing corrective actions such as flow line purging until the system regains normal operational status (Fig. 2).

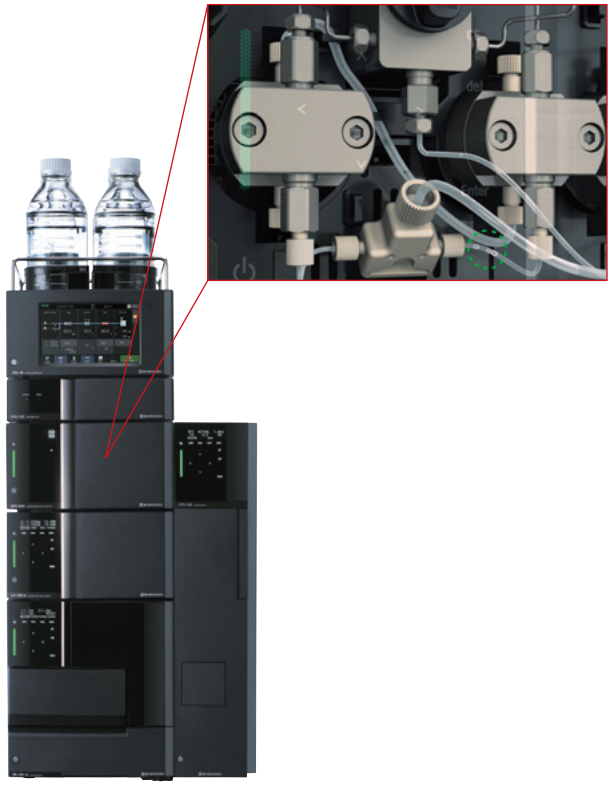

Fig. 1 Diagram of the Nexera™ solvent delivery unit flow lines

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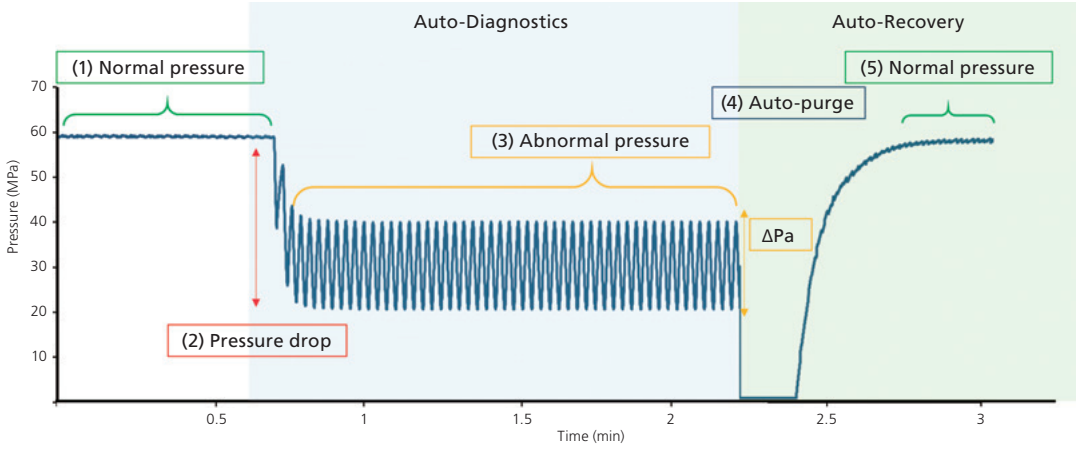

Fig. 2 Pressure changes during auto-diagnostics and auto-recovery. The time spent in each phase can vary depending on analytical conditions and user-defined settings.

3. Fully-automatic Recovery

Auto-diagnostic and auto-recovery functions are based on a specific algorithm providing the following capabilities. When air bubbles appear in the system, the pressure will drop (Fig. 2, stage 2), and this abnormal pressure will continue (Fig. 2, stage 3). If the new pressure variability ΔPa is abnormal compared to the reference value, the auto-recovery function will be triggered.

In this case, all the subsequent analyses are temporarily suspended. An auto-purge is performed in order to remove any air bubbles from the flow lines (Fig. 2, stage 4) and a column rinse is performed.

After the auto-recovery process, the pressure profile is checked and compared to the reference values. If pressure variability is normal, the system will return automatically to analysis mode and resume all analyses in the queue.

After auto-recovery, the user can choose to start the interrupted analysis again or to skip this and start from the next line of the batch.

4. User Settings

The settings for the auto-diagnostics and auto-recovery functions can be easily changed with LabSolutions™. First, if the system detects that the pressure is abnormal, select the operation to be performed as follows.

Enter auto-recovery mode: Auto-purge is performed.
Ignore: No action is performed.
Stop batch processing: Analysis stops and the system goes to standby.

In addition, it is possible to customize the purge time at the time of auto-recovery, the number of attempts at recovery, and the steps after recovery (Fig. 3).

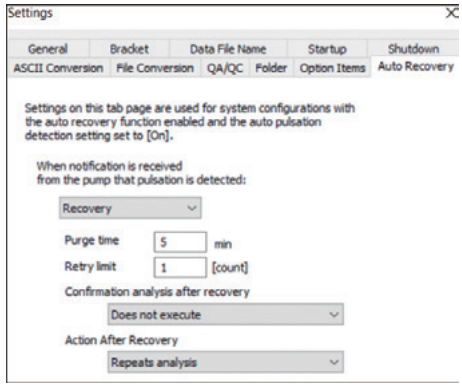

Fig. 3 LabSolutions auto-recovery settings window

5. Conclusions

- Auto-diagnostics and auto-recovery functions are available using all Nexera solvent delivery units being controlled via LabSolutions software.
- Both functions are fully automatic and do not require any human intervention, resulting in increased overall analytical efficiency.

References

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