Technical Overview

Comparison of the Agilent Nitrogen Phosphorus Detector Operation on the Agilent 7890 GC and the Agilent 8890 GC

Introduction

The Agilent nitrogen phosphorus detector (NPD) selectively responds to organic nitrogen- and phosphorus-containing compounds, which are common in environmental, forensics, toxicology, and food safety applications. The NPD uses an alkali salt bead to generate a hydrogen and air plasma at the bead surface. The plasma is responsible for the selective detection of nitrogen and phosphorus compounds. To initiate the plasma, the temperature of the bead is raised by passing current through an electrical lead. Once the plasma is initiated, alkali ions emit electrons from the bead which generate a standing current or offset that is sensed by the electrometer; this is known as detector baseline. When organic nitrogen- and phosphorus-containing compounds elute from the column and enter the hot bead containing the plasma, the heteroatoms are absorbed and ionized, reducing the work function of the bead surface. The result is an increase in electron emission which is sensed by the electrometer. Sensitivity of the detector is a function of the number of alkali ions that are within the plasma – a higher standing current yields greater sensitivity. However, running the standing current too high will shorten the life of the bead.

For the Agilent NPD, the recommended standing current is between 20 and 40 pA. As the bead ages, higher bead temperatures are necessary to generate the same standing current as the alkali ions must migrate to the surface of the bead to enter the plasma. The standing current (baseline signal) or offset is the indicator that the bead is operating properly. This technical overview discusses notable differences regarding the NPD and its operation with the Agilent 7890 GC and the Agilent 8890 GC.

Experimental

7890 GC versus 8890 GC bead

NPD setup with the 7890 GC or 8890 GC differs in the ceramic beads that each system supports. The 7890 GC NPD supports the use of any of these ceramic bead assemblies:

- Agilent black ceramic bead assembly (part number 51832007)
- Agilent white ceramic bead assembly (part number G153460570)
- Agilent Blos ceramic bead assembly (part number G343460806)

The 8890 GC NPD only supports the use of the Blos ceramic bead assembly. The Blos bead was chosen as the only bead type for the 8890 GC because of its insensitivity to ambient humidity and moisture. The Blos bead has stable operation across its lifetime and has demonstrated twice the operational lifetime compared to the white ceramic bead. The Blos bead can be in a ready state two to three times faster than the black or white ceramic bead assemblies used in the 7890 GC. In addition, the Blos bead provides superior sensitivity and selectivity for phosphorus- and nitrogen-containing compounds due to decreased drift in analyte response (approximately 2%) compared to the other ceramic beads (approximately 24%).

Results and discussion

7890 GC versus 8890 GC bead operation

From an operational perspective, the difference between the 7890 and 8890 GC NPDs is in how the beads are controlled in each instrument generation. The 7890 GC controls the NPD bead temperature by controlling the voltage potential applied to the electrical lead. In contrast, the 8890 GC controls the NPD bead temperature by controlling the current applied through the electrical lead. In the 7890 GC, bead voltage is the instrument control parameter, set by the user, that generates the standing current. For an aging bead in a 7890 GC, the bead voltage needs to be increased manually to maintain detector sensitivity. For example, a new Blos bead at 0.8 V will give the same sensitivity as an older Blos bead at 1.0 V, provided the standing current is the same. The control to adjust the offset is necessary to allow the bead standing current or its offset to be set to a similar level for use. For stable response, once the offset is achieved, the instrument maintains that voltage until the user manually starts an action to adjust the offset. The control is done at the instrument rather than as a method parameter, which has been the case in all previous generation instruments. If the offset adjustment is done as part of the method, the sensitivity of the bead will be changed as each method is loaded, causing a need for recalibration.

In the development of the 8890 GC, the switch was made to control the current of the NPD bead through the electrical lead. Not only is the operation simpler, but it provides better bead power control by being able to compensate for variability in resistances in the cables and connections to the bead.

The result of this change is that on the 8890 GC the user can no longer specify the target bead voltage as a setpoint for the NPD as on the 7890 GC. Instead, users will directly specify the target offset, making the ability to set a bead voltage no longer necessary. As previously stated, the bead standing current or offset is the true indicator of bead performance. Recording the target voltage is not of value as this does not indicate how the bead is performing for a particular analysis. The actual bead standing current or offset is recorded in the chromatogram for every run, which can be seen in the baseline before the first components elute. The actual bead standing current or offset is a true indicator of the bead status.

When using an 8890 GC, specification of the target bead baseline current or offset is performed one of two ways. The offset can be set from the Control tab within the data system acquisition software (e.g. Agilent OpenLab CDS), shown in Figure 1. Alternatively, the offset can be set from the Configuration screen of the local user interface (**Settings > Configuration > Detectors > NPD**), shown in Figure 2. The 8890 GC control of the NPD bead to this target current is optimized by an automatic adjustment

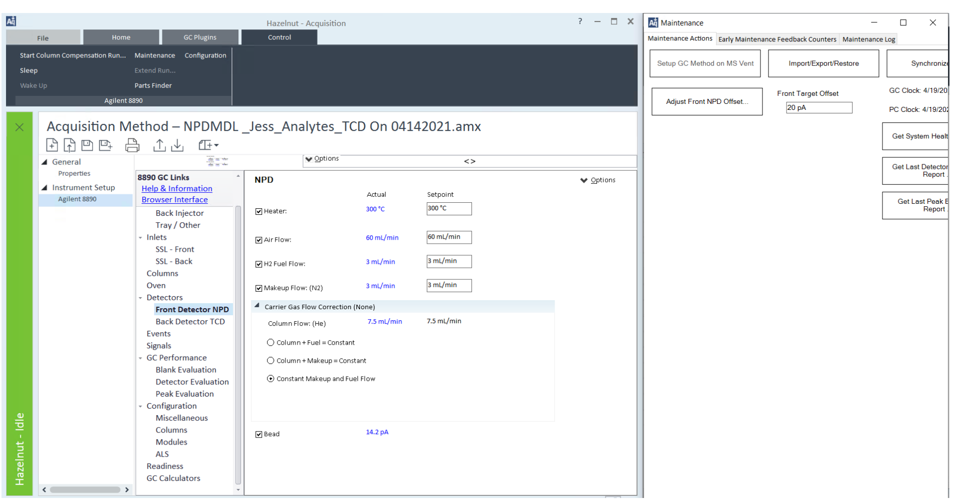

Figure 1. NPD target offset and automatic adjustment button in Agilent OpenLab CDS.

algorithm. The algorithm is invoked every time the bead is turned on or on demand from the browser under the NPD detector settings within the method editor or from the Maintenance screen within the data system (see Figure 1).

Conclusion

This overview highlights the differences of the Agilent nitrogen phosphorus detector (NPD) when used with either the Agilent 7890 GC or the Agilent 8890 GC. Hardware setup and function as well as software control of the NPD are compared between the GC systems.

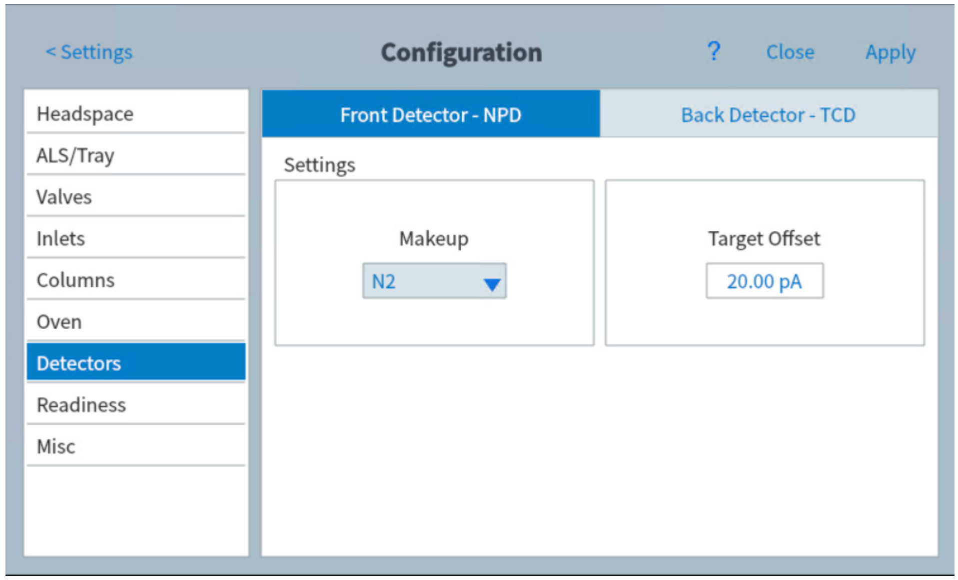

Figure 2. Local user interface of the Agilent 8890 GC where the NPD target offset can be entered.

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DE44320.308587963

Printed in the USA, May 13, 2021
5994-3577EN

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