ABB MEASUREMENT & ANALYTICS | APPLICATION NOTE

Determination of ACH, free HCN, DEA, water, acidity, SO_2 and acetone in ACH process

FT-NIR technology provides fast analysis for multiple properties in one operation.

Measurement made easy

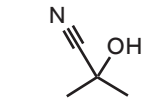
Overview

Acetone cyanohydrin (ACH) is an organic compound used in the production of methyl methacrylate, the monomer of the transparent plastic polymethyl methacrylate (PMMA), also known as acrylic.

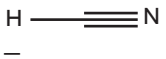
ACH process consists in three different stages called reactor, crude, and pure product.

The purpose of this study is to assess the feasibility of determination following chemical properties in the three different process stages by FT-NIR to provide real-time feedback and optimize process. Those properties are ACH, free HCN, and diethyl amine (DEA) in reactor, water and SO_2 in crude and acetone, acidity, water and phenothiazine (PTZ) in pure product.

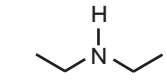
The main advantages of applying FT-NIR technology are to provide fast analysis for multiple properties in one operation, no sample preparation, and low maintenance.



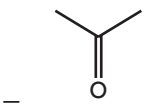
01 Acetone cyanohydrin



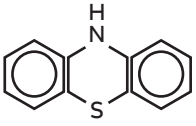
02 HCN



03 Diethylamine



04 Acetone



05 Phenothiazine

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01 Actual vs predicted for ACH in reactor

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02 FT-NIR calibration performance table

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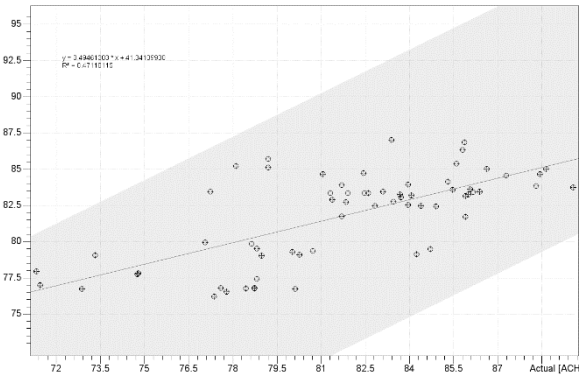
03 MB3600 FT-NIR analyzer

Application details

Method

- Instrument: ABB MB3600 FT-NIR analyzer
- Detector: InAs, thermoelectrically cooled
- Sampling technique: vial holder 12 mm
- Resolution: 16 cm^{-1}
- Number of scans: 128

Results



Note: four samples were removed as concentration outliers; calibration was created with samples from three reactors only.

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Property	Range	R^2	Uncertainty (1*σ)
ACH (reactor)	71.3 to 89.6 %	0.47	3.07
Free HCN (reactor)	0.03 to 7.07 %	0.73	0.77
DEA (reactor)	0.05 to 0.12 %	0.74	0.0077
H_2O (crude)	0.94 to 4.8 %	0.90	0.29
SO_2 (crude)	71 to 1097 ppm	0.81	125.5
Acetone (product)	0.28 to 0.64 %	0.69	0.04
H_2O (product)	0.15 to 1.2 %	0.69	0.08
Acidity (product)	0.1 to 0.21 %	0.72	0.013

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Conclusion

The results show that it is feasible to determine ACH, free HCN, DEA, water, acidity, SO_2 and acetone in ACH process by ABB FT-NIR technology.

The current samples obtained are not sufficient to represent the process conditions and not well spread over the measurement range of each properties (e.g., H_2O in product). The results could be improved with more representative process samples that could span the variety of process conditions.

It is suggested that 5 mm vials or sample cell path lengths could be used in order to cover the full OH 1st overtone region, thus obtaining more signatures or information related to the chemical properties containing the OH/NH function group (such as ACH, DEA and acidity).

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