Application Note AN-T-204

Permanganate index in water

Fully automated determination according to GB/T 11892

The permanganate index (PMI) is a sum parameter that indicates the total load of oxidizable organic and inorganic matter in water. The substances concerned are mainly humic materials/acids that are primarily formed when dead organic material present in soil is further broken down and released into water sources. Another source of organic material in the water can be attributed to birds or fish. As it is an indicator of the water quality, testing of the PMI for drinking water is obligatory in many countries.

For the determination, it is necessary to heat the stabilized water sample to 95 °C and higher for a stipulated time. Afterwards, the amount of permanganate that has remained after the reaction with the sample is determined titrimetrically. This sample preparation step requires considerable manual effort.

In this Application Note, a fully automated procedure for the determination of the PMI according to GB/T 11892 is described, including all sample preparation steps. The gains in productivity because of a reduced manual workload are considerable.

SAMPLE AND SAMPLE PREPARATION

The application is demonstrated for a resorcinol standard (6 mg/L corresponding to a PMI of 9.32–10.28 mg/L) and a water sample from a stream.

To stabilize the sample, sulfuric acid is added directly after sampling.

EXPERIMENTAL

The analysis is carried out on an automated system using an 810 Sample Processor with an external jacketed vessel, 916 Ti-Touch, a Pt Titrode for indication, and a Pt1000 temperature sensor.

The stabilized sample is poured into a titration beaker, which is then covered with aluminum foil, fixed with a foil holder, and placed on the sample rack.

For the sample determination, an aliquot of sample is pipetted into the external vessel. Sulfuric acid and potassium permanganate solution are added. The solution is heated up and the temperature is maintained for 30 minutes between 96–98 °C. Sodium oxalate solution is added, and its excess is then back-titrated with standardized potassium permanganate until after the equivalence point.

After the determination, the vessel is automatically emptied and rinsed twice with deionized water. The transfer tube is also rinsed with deionized water. A blank determination is performed in the same way, by replacing the sample with the same amount of deionized water.

Figure 1. 916 Ti-Touch and 810 Sample Processor. Example setup for the determination of the permanganate index in water.

RESULTS

According to EN ISO 8467, a resorcinol standard of 6 mg/L has a PMI between 9.32 and 10.28 mg/L. The analysis demonstrates acceptable and reproducible results for the standard and the sample, which are summarized in Table 1. An example titration curve is displayed in Figure 2.

Table 1. Mean PMI value for two different samples determined by a fully automated titration system (n = 5).

Sample	PMI / mg/L	SD(rel) / %
Resorcinol standard	10.04	1.75
Stream water	8.93	0.92

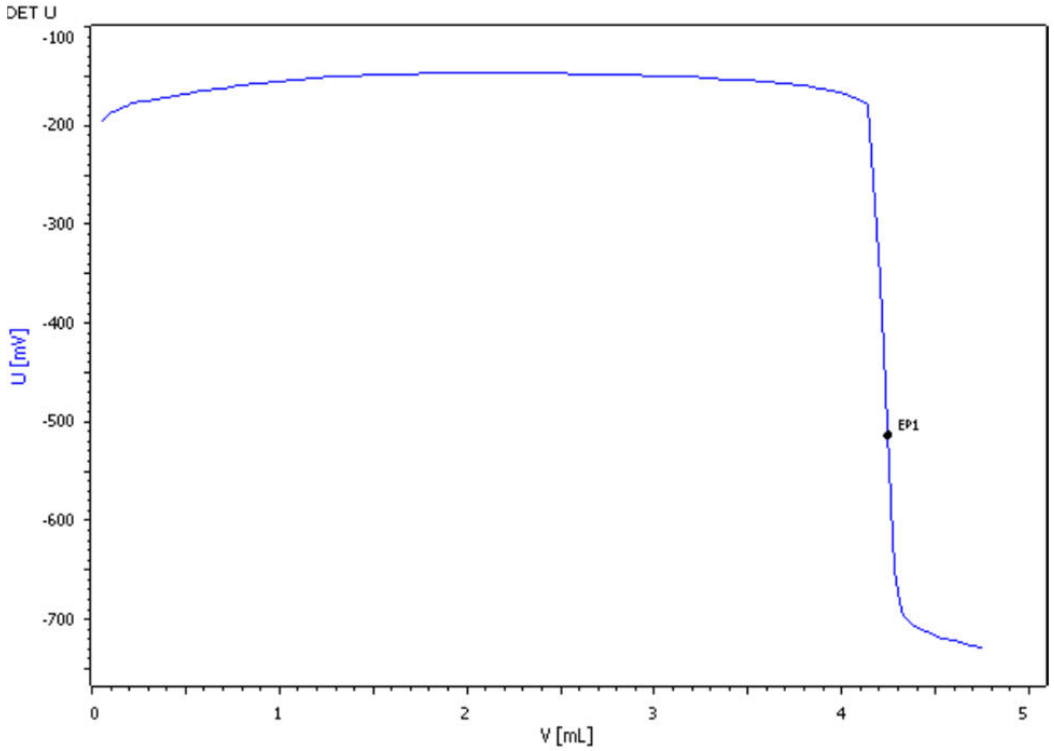

Figure 2. Example titration curve for the permanganate index determination in a stream water sample.

CONCLUSION

The determination of the PMI value in water samples can efficiently be carried out by using a Metrohm autotitrator equipped with an automation system. Fast and precise determination according to GB/T 11892 is possible. Furthermore, by fully automating all sample preparation steps, the productivity within the laboratory is significantly increased.

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CONFIGURATION

916 Ti-Touch with magnetic stirrer

''Reduce to the max'' – this is the 916 Ti-Touch concept. The compact titrator from Metrohm offers the maximum in the class of stand-alone systems for routine analysis.

The 916 Ti-Touch with built-in magnetic stirrer supports all potentiometric titrations: the titration modes DET (dynamic equivalence point titration), MET (monotonic equivalence point titration), SET (titration to one or two specified endpoints), STAT (enzymatic and pH-STAT titrations), and MAT (manual titration).

The 916 Ti-Touch now also fulfills FDA Regulation 21 CFR, Part 11. This means you are always on the safe side when it comes to audits.
With the 810 Sample Processor, you are supplementing the 916 Ti-Touch with automation and thus enhancing your sample throughput and improving the precision and reproducibility of your results.

810 Sample Processor

Sample Processor for the automated analysis of routine samples using 916 Ti-Touch or 915 KF Ti-Touch.

Sample Processor with one workstation and one built-in membrane pump for the automatic processing of potentiometric as well as Karl Fischer titrations, in series with small to medium quantities. In addition to the built-in pump, an additional one (membrane or peristaltic) and up to three dosing devices for Liquid Handling tasks can be connected.

Because of the multitude of application variants, rack, stirrer, titration head, Swing Head and sample vessels must be tailored to the application and ordered separately.

iPt Titrode

Combined platinum ring electrode with a pH glass membrane as reference electrode and integrated memory chip for storing sensor data.

This maintenance-free electrode is suitable for redox titrations when the pH value remains constant, e.g.:

- Iodometry
- Chromatometry
- Cerimetry
- Permanganometry

This electrode is stored in distilled water.

iTrodes can be used on Titrando, Ti-Touch oder 913/914 meters.