

TRICHLOROETHYLENE by portable GC

3701

Cl₂C=CHCl

MW: 131.39

CAS: 79-01-6

RTECS: KX4550000

METHOD: 3701, Issue 2

EVALUATION: FULL

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OSHA : 100 ppm; C 200 ppm; P 300 ppm
NIOSH: 25 ppm; C 2 ppm/1 h; carcinogen
ACGIH: 50 ppm; 200 ppm STEL; suspect carcinogen
 (1 ppm = 5.37 mg/m³ @ NTP)

PROPERTIES: liquid; d 1.46 g/mL @ 20 °C; BP 87 °C;
 MP -86 °C; VP 7.7 kPa (58 mm Hg);
 7.6% v/v @ 20 °C; explosive range
 11 to 41% v/v in air

SYNONYMS: trichloroethene; ethylene trichloride; triclene

APPLICABILITY: The working range is 10 to 1000 ppm (54 to 5400 mg/m³) in relatively non-complex atmospheres where trichloroethylene is known to be present (see EVALUATION OF METHOD).

INTERFERENCES: None found.

OTHER METHODS: Method 1022 [1] uses activated charcoal sampler tubes.

REAGENTS:

1. Trichloroethylene (TCE)* in air, working standards prepared in the field by filling Tedlar bags with commercially prepared and certified standards (preferred) or prepared in the field by injecting known amounts of pure trichloroethylene into Tedlar bags containing a metered volume of pure air or nitrogen.
2. Cylinder of air, nitrogen or helium for use as carrier gas and field blanks.

* See SPECIAL PRECAUTIONS.

EQUIPMENT:

1. Portable gas chromatograph (GC), with photoionization detector, preferably with gas sampling loop and (if appropriate) strip chart recorder.
2. Personal sampling pump, 0.02 to 0.05 L/min or other rate suitable for filling sample bag, with flexible connecting tubing.
3. Bags, Tedlar, 2- to 20-L or other appropriate sizes.
4. Syringes, gas-tight, of various sizes appropriate to the GC, and for preparation of bag standards.

NOTE: To reduce the possibility of contamination, use separate, previously unused syringes for working standards and samples. Test syringes for contamination occasionally by filling them with clean air and analyzing the contents.

5. Label tape and marking pen for labelling bags.

SPECIAL PRECAUTIONS: TCE is a suspect carcinogen [2]. Shipment of compressed gases must comply with 49 CFR 171-177 regulations regarding shipment of hazardous materials.

SAMPLING AND MEASUREMENT:

1. Start GC instrument and recorder and allow to warm up according to manufacturer's instructions.
NOTE: A straight line baseline should be attained at the highest sensitivity likely to be used.
2. Select one of the following sampling modes:
 - a. **Spot sample.** Draw air sample into the gas sampling loop of the GC with the on-board sampling pump, if supplied. Alternatively, inject an aliquot of air to be sampled into the GC with a gas-tight syringe.

NOTE: A large contributor to random error in the method is imprecision of replicate injections. To improve precision:

- (1) use a gas sampling loop for injections, if available;
 - (2) make at least three replicate determinations per sample;
 - (3) use an injection volume large enough to be precisely readable, and consistent with that used in calibration; and
 - (4) set conditions such that peaks are at least 50% of full scale.
- b. **Integrated air sample for TWA determination.**
 - (1) Evacuate a clean sample bag using the inlet port of a personal sampling pump.
NOTE: To reduce memory effects and contamination, use only previously unused sample bags.
 - (2) Attach the sample bag to a personal sampling pump suitable for bag filling with a minimum length of flexible tubing.
 - (3) Pump the air to be sampled into the sample bag at a rate calculated to fill $\leq 80\%$ of the sample bag capacity over the sampling period.
NOTE: The flow rate must remain within $\pm 5\%$ of the initial setting throughout the sampling period.

- (4) Within 4 hrs after completion of sampling, introduce an aliquot of the sample into the GC (as in step 2.a).
3. Obtain the TCE peak height of the injected sample.

CALIBRATION AND QUALITY CONTROL:

4. Perform the following in the laboratory before field work begins:
 - a. Establish a laboratory calibration graph by at least three replicate determinations of at least six working standards. Plot peak height vs. mass of TCE.
 - b. Determine detector drift, averaged over the time period(s) expected to be used in the field.
 - c. Determine the ability of the GC column to separate the TCE peak from other substances known or predicted to be present in the field samples.
5. Establish a daily calibration graph (peak height vs. ng of TCE) by triplicate determinations of working standards under the same conditions as for samples (step 2.a). Alternate analyses of samples and working standards, if possible.

CALCULATIONS:

6. Calculate mass, W (ng), of TCE in sample by comparison of peak height with daily calibration graph (step 5). Determine concentration, C , of TCE in the injected sample, V (mL):

$$C = \frac{W}{V}, \text{ mg/m}^3.$$

NOTE: Some GCs perform this calculation electronically.

EVALUATION OF METHOD:

This method was evaluated using an AID Model 590 portable GC. Gas bags containing known amounts of TCE in air were used to establish the calibration graph. The response of the portable GC was then compared to the concentration obtained from analysis of replicate charcoal tube samples taken from the same bag. A six-inch strip chart recorder was used to obtain peak height data from the portable GC.

A limitation in the use of this type of portable GC (e.g., packed column, room temperature isothermal) is the limited ability to separate the analyte from any interferences present. In the evaluation of this method, a six-foot DC 200 column was used. Its ability to separate the TCE peak from other contaminants was not evaluated. However, the use of this or any other packed column operated at room temperature to separate complex mixtures is severely limited. Therefore, the application of this method should be confined to relatively uncomplicated atmospheres.

REFERENCES:

- [1] NIOSH Manual of Analytical Methods, 3rd ed., V. 2, NMAM 1022. U.S. Department of Health and Human Services, Publ. (NIOSH) 84-100 (1984).
- [2] NIOSH Current Intelligence Bulletin 2, Trichloroethylene, NIOSH (June 6, 1975), U.S. Department of Health, Education, and Welfare, Publ. (NIOSH) 78-127 (1979).

METHOD WRITTEN BY:

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