Methanolic H_2SO_4 (10% v/v)

Product Specification

Methanolic H_2SO_4, 10% v/v (sulfuric acid in methanol) is particularly useful for preparing methyl esters of carboxylic acids and esters. The esters are prepared from the anhydrous alcohol (methanol) in the presence of an acid (e.g., H_2SO_4) or other catalyst, as described in the **Mechanism** section of this information sheet.

One of the main advantages of H_2SO_4 over other catalysts is that it does not produce fluoroanhydrides on acylation with acid anhydrides and does not form HF when phenols or alkyl ethers of phenols are acylated. On the other hand, H_2SO_4 can have dehydrating reactions, charring effects, and/or oxidative side reactions if used carelessly.

Applications/Benefits

Methanolic H_2SO_4, 10% v/v, is useful for esterifying acids and transesterifying esters.

Clean reaction (no side reactions) with volatile byproducts.

Provides convenient, fast, quantitative derivatization.

Typical Procedure

This procedure is intended to be a guideline and may be adapted as necessary to meet the needs of a specific application. Always take proper safety precautions when using an esterification reagent – consult MSDS for specific handling information.

Prepare a reagent blank (all components, solvents, etc., *except sample*), following the same procedure as used for the sample.

1. Weigh 1-25mg of sample into a 5mL reaction vessel. If appropriate, dissolve sample in nonpolar organic solvent (e.g., hexane, ether, toluene). If sample is in aqueous solution, evaporate to dryness, then use neat or redissolve in organic solvent.
2. Add 2mL methanolic H_2SO_4, 10% v/v, and mix. A water scavenger (e.g., 2,2-dimethoxypropane) can be added at this point. (Water can prevent the reaction from going to completion, producing low yields.)
3. Heat at 60°C for 30 minutes. Allow mixture to cool to room temperature, then add 1mL saturated sodium bicarbonate solution, to neutralize the reagent, and 1mL hexane.
4. Shake the mixture. It is critical to get the esters into the organic solvent.
5. Allow phases to separate, then carefully remove upper (organic) layer and dry it over anhydrous sodium sulfate.
6. Analyze 1µL aliquot (it may be necessary to dilute the sample for GC/ECD analysis).

   Derivatization times vary widely, depending upon the specific compound(s) being derivatized. If derivatization is not complete, use additional reagent or reevaluate temperature/time of reaction.

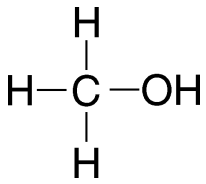
Properties

Sulfuric Acid

CAS Number: 7664-93-9
Molecular Formula: H_2SO_4
Formula Weight: 98.08
bp: ~290°C (at 340°C decomposes into SO_3 + H_2O
d: ~1.84
Appearance:
colorless, odorless (but highly pungent), oily liquid

Methanol

Structure:



CAS Number: 67-56-1
Molecular Formula: CH_3OH
Formula Weight: 32.04
bp: 64.7°C
Flash Point: 52°F (11°C)
d: 0.791
n_D: 1.3290 at 20°C
Appearance:
clear, colorless liquid

797-0187

Esterification

$$\text{R-COOH} + \text{CH}_3\text{OH} \xrightarrow{\text{acid } (H_2SO_4)} \text{R-COO-CH}_3 + \text{H}_2\text{O}$$

Adapted from (1).

Transesterification

$$\text{R-COOR'} + \text{CH}_3\text{OH} \xrightarrow{\text{acid } (H_2SO_4)} \text{R-COO-CH}_3 + \text{R'-OH}$$

Adapted from (3).

Mechanism (1,2,3)

Esterification

Esterification involves heating the carboxylic acid with an acid catalyst in an alcohol solvent. The catalyst protonates an oxygen atom of the reactive COOH group, making the molecule much more reactive to nucleophiles. An alcohol molecule then combines with the protonated group, to yield the ester product ($R\text{-}COO\text{-}CH_3$) with loss of water. Esterification is a reversible reaction. Water must be removed to drive the reaction to the right and obtain a high ester yield. A chemical reagent can be used to remove water as it is formed or, if the reaction is conducted at a temperature above 100°C, water may distill off as it is formed. 2,2-dimethoxypropane can be introduced into the reaction mixture to react with the water, yielding acetone. Other water scavengers are anhydrous sulfuric acid and graphite bisulfate.

Transesterification

In transesterification, the alcohol is displaced from the ester by another alcohol (e.g., methanol) in a process similar to hydrolysis (the second alcohol is used instead of water), forming a new ester. Transesterification also is an equilibrium reaction. To shift the reaction to the right, it is necessary to use a large excess of the second alcohol, or to remove one of the products from the reaction mixture. Conversion is maximized if excess alcohol is used. The conversion rate also is influenced by the reaction temperature – the reaction generally is conducted near the boiling point of the alcohol.

Toxicity - Hazards - Storage - Stability

Methanolic H_2SO_4, 10% v/v, is a flammable, corrosive, toxic liquid. It may irritate eyes, skin, and/or the respiratory system. Recommended storage conditions for the unopened product are stated on the label. Store opened reagent in a sealed bottle or ampul. **If you store an opened container or transfer the contents to another container for later reuse, validate that your storage conditions adequately protected the reagent**.

Use only in a well ventilated area and keep away from ignition sources. Moisture can hinder the reaction – it may be necessary to dry the solvents before conducting the reaction.

The reagent has a limited shelflife, even when refrigerated, and the use of old or excessively concentrated solutions (through alcohol evaporation) often produces artifacts and a significantly lower reaction yield.

References

1. K. Blau and J. Halket *Handbook of Derivatives for Chromatography* (2nd ed.) John Wiley & Sons, New York (1993).
2. D.R. Knapp *Handbook of Analytical Derivatization Reactions* John Wiley & Sons, New York (1979).
3. *Bailey's Industrial Oil and Fat Products*, fifth edition, Vol. 5, John Wiley & Sons, New York (1995).

Additional Reading

R. Kleiman, G.F. Spencer, F.R. Earle *Boron Trifluoride as Catalyst to Prepare Methyl Esters from Oils Containing Unusual Acyl Groups* Lipids, **4** (2): 118-122 (1968).

E.S. Woodbury, P.R. Evershed, J.B. Rossell, R.E. Griffith, P. Farnell *Detection of Vegetable Oil Adulteration Using Gas Chromatography Combustion-Isotope Ratio Mass Spectrometry* Anal. Chem., **67:** 2685-2690 (1995).

R.M. Le-Lacheur, L.B. Sonnenberg, P.C. Singer, R.F. Christman, M.J. Charles *Identification of Carbonyl Compounds in Environmental Samples* Environ. Sci. Technol., **27:** 2745-2753 (1993).

X. Yan, P.J. Barlow, C. Craven *Discrimination in Recovery During Capillary GLC Analysis of Fish Oil: The Use of a Recovery Correction Factor* Food Chem., **40:** 93-99 (1991).

References not available from Supelco.

Ordering Information:

Description	Cat. No.
Methanolic H_2SO_4, 10% v/v	
6 x 5mL	**506516**
Microreaction Vessels with Hole Caps and Septa	
pk. of 12	
1mL	**33293**
3mL	**33297**
5mL	**33299**
Books	
Handbook of Derivatives for Chromatography	
K. Blau and J. Halket	**26566-U**
Handbook of Analytical Derivatization Reactions	
D.R Knapp	**23561**

Contact our Technical Service Department (phone 800-359-3041 or 814-359-3041, FAX 800-359-3044 or 814-359-5468) for expert answers to your questions.