Methanolic \( \text{H}_2\text{SO}_4 \) (10% v/v)  

Product Specification

Methanolic \( \text{H}_2\text{SO}_4 \), 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., \( \text{H}_2\text{SO}_4 \)) or other catalyst, as described in the Mechanism section of this information sheet.

One of the main advantages of \( \text{H}_2\text{SO}_4 \) 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, \( \text{H}_2\text{SO}_4 \) can have dehydrating reactions, charring effects, and/or oxidative side reactions if used carelessly.

Applications/Benefits
Methanolic \( \text{H}_2\text{SO}_4 \), 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 \( \text{H}_2\text{SO}_4 \), 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:** \( \text{H}_2\text{SO}_4 \)
- **Formula Weight:** 98.08
- **bp:** \( \sim 290°C \) (at 340°C decomposes into \( \text{SO}_3 \) + \( \text{H}_2\text{O} \))
- **d:** \( \sim 1.84 \)

**Appearance:** colorless, odorless (but highly pungent), oily liquid

**Methanol**

- **Structure:**


- **CAS Number:** 67-56-1
- **Molecular Formula:** \( \text{CH}_3\text{OH} \)
- **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

\[
\text{acid (H}_2\text{SO}_4) + \text{R-COOH} \rightarrow \text{R-COOH} - \text{CH}_3 + \text{H}_2\text{O}
\]

Adapted from (1).

Transesterification

\[
\text{acid (H}_2\text{SO}_4) + \text{R-COO}- \text{CH}_3 + \text{R'} \rightarrow \text{R-COO}- \text{CH}_3 + \text{R'-OH}
\]

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 more reactive to nucleophiles. An alcohol molecule then combines with the protonated group, to yield the ester product \((\text{R-COO-CH}_3)\) with loss of water. Esterification is a reversible reaction. Water must be removed to drive the reaction to the right and obtain an acid 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 \(\text{H}_2\text{SO}_4\), 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 protect 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 excessively concentrated solutions (through alcohol evaporation) often produces artifacts and a significantly lower reaction yield.

**References**


**Additional Reading**


References not available from Supelco.

**Ordering Information:**

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**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.