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Acetic acid and sodium chloride

Chemical compound This article is about sodium acetate. For other uses of hot ice, see Hot ice (disambiguation). Sodium acetate Names Preferred IUPAC name Sodium acetate Other names Hot ice (sodium acetate trihydrate) Identifiers CAS Number anhydrous: 127-09-3 Ytrihydrate: 6131-90-4 Y 3D model (JSmol) anhydrous: Interactive image Beilstein Reference 3595639 ChEBI anhydrous: CHEBI:32954 Ytrihydrate: CHEBI:32138 ChEMBL anhydrous: ChEMBL1354 Y ChemSpider anhydrous: 29105 Y DrugBank anhydrous: DB09395 ECHA InfoCard 100.004.386 EC Number anhydrous: 204-823-8 E number E262 (preservatives) Gmelin Reference 20502 KEGG trihydrate: D01779 PubChem CID anhydrous: 517045trihydrate: 23665404 RTECS number anhydrous: AJ4300010 (anhydrous)AJ4580000 UNII anhydrous: NVG71ZZ7P0 Ytrihydrate: 4550K0SC9B Y CompTox Dashboard (EPA) anhydrous: DTXSID2027044 InChI InChI=1S/C2H4O2.Na/c1-2(3)4;/h1H3,(H,3,4);/q;+1/p-1 YKey: VMHLLURERBWHNL-UHFFFAOYSA-M Yanhydrous: InChI=1/C2H4O2.Na/c1-2(3)4;/h1H3,(H,3,4);/q;+1/p-1Key: VMHLLURERBWHNL-REWHXWOFAT SMILES anhydrous: [Na+].[O-]C(=O)C Properties Chemical formula C2H3NaO2 Molar mass 82.034 g·mol−1 Appearance White deliquescent powder Odor Vinegar (acetic acid) odor when heated to decomposition[1] Density 1.528 g/cm3 (20 °C, anhydrous) 1.45 g/cm3 (20 °C, trihydrate)[2] Melting point 324 °C (615 °F; 597 K) (anhydrous) 58 °C (136 °F; 331 K) (trihydrate) Boiling point 881.4 °C (1,618.5 °F; 1,154.5 K) (anhydrous) 122 °C (252 °F; 395 K) (trihydrate) decomposes Solubility in water Anhydrous: 119 g/100 mL (0 °C) 123.3 g/100 mL (20 °C) 125.5 g/100 mL (30 °C) 137.2 g/100 mL (60 °C) 162.9 g/100 mL (100 °C) Trihydrate: 32.9 g/100 mL (-10 °C) 36.2 g/100 mL (0 °C) 46.4 g/100 mL (20 °C) 82 g/100 mL (50 °C)[3] Solubility Soluble in alcohol, hydrazine, SO2[4] Solubility in methanol 16 g/100 g (15 °C) 16.55 g/100 g (67.7 °C)[4] Solubility in ethanol Trihydrate: 5.3 g/100 mL Solubility in acetone 0.5 g/kg (15 °C)[4] Acidity (pKa) 24 (20 °C)[4] 4.75 (when mixed with CH3COOH as a buffer)[5] Basicity (pKb) 9.25 Magnetic susceptibility (χ) −37.6·10−6 cm3/mol Refractive index (nD) 1.464 Structure Crystal structure Monoclinic Thermochemistry Heat capacity (C) 100.83 J/mol·K (anhydrous)[6] 229 J/mol·K (trihydrate)[7] Std molarentropy (So298) 138.1 J/mol·K (anhydrous)[6] 262 J/mol·K (trihydrate)[2] Std enthalpy offormation (ΔfH298) −709.32 kJ/mol (anhydrous)[4] −1604 kJ/mol (trihydrate)[2] Gibbs free energy (ΔfG˚) −607.7 kJ/mol (anhydrous)[4] Pharmacology ATC code B05XA08 (WHO) Hazards Main hazards Irritant Safety data sheet External MSDS NFPA 704 (fire diamond) 1 1 0 Flash point >250 °C (482 °F; 523 K) [5] Autoignitiontemperature 600 °C (1,112 °F; 873 K)[5] Lethal dose or concentration (LD, LC): LD50 (median dose) 3530 mg/kg (oral, rat) Related compounds Other anions Sodium formate Sodium propionate Other cations Potassium acetate Calcium acetate Related compounds Sodium diacetate Except where otherwise noted, data are given for materials in their standard state (at 25 °C [77 °F], 100 kPa). N verify (what is YN ?) Infobox references Chemical compound Sodium acetate, NaCH3COO, also abbreviated NaOAc,[8] is the sodium salt of acetic acid. This colorless deliquescent salt has a wide range of uses. Applications Biotechnological Sodium acetate is used as the carbon source for culturing bacteria. Sodium acetate is also useful for increasing yields of DNA isolation by ethanol precipitation. Industrial Sodium acetate is used in the textile industry to neutralize sulfuric acid waste streams and also as a photoresist while using aniline dyes. It is also a pickling agent in chrome tanning and helps to impede vulcanization of chloroprene in synthetic rubber production. In processing cotton for disposable cotton pads, sodium acetate is used to eliminate the buildup of static electricity. Concrete longevity Sodium acetate is used to mitigate water damage to concrete by acting as a concrete sealant, while also being environmentally benign and cheaper than the commonly used epoxy alternative for sealing concrete against water permeation.[9] Food Sodium acetate may be added to food as a seasoning, sometimes in the form of sodium diacetate, a one-to-one complex of sodium acetate and acetic acid,[10] given the E-number E262. It is often used to give potato chips a salt and vinegar flavor.[citation needed] Sodium acetate (anhydrous) is widely used as a shelf-life extending agent, pH control agent[11] It is safe to eat at low concentration.[12] Buffer solution A solution of sodium acetate (a basic salt of acetic acid) and acetic acid can act as a buffer to keep a relatively constant pH level. This is useful especially in biochemical applications where reactions are pH-dependent in a mildly acidic range (pH 4–6). Heating pad A hand warmer containing a supersaturated solution of sodium acetate which releases heat upon crystallization Sodium acetate is also used in heating pads, hand warmers, and hot ice. Sodium acetate trihydrate crystals melt at 136.4 °F/58 °C[13] (to 137.12 °F/58.4 °C),[14] dissolving in their water of crystallization. When they are heated past the melting point and subsequently allowed to cool, the aqueous solution becomes supersaturated. This solution is capable of cooling to room temperature without forming crystals. By pressing on a metal disc within the heating pad, a nucleation center is formed, causing the solution to crystallize back into solid sodium acetate trihydrate. The bond-forming process of crystallization is exothermic.[15] The latent heat of fusion is about 264–289 kJ/kg.[13] Unlike some types of heat packs, such as those dependent upon irreversible chemical reactions, a sodium acetate heat pack can be easily reused by immersing the pack in boiling water for a few minutes, until the crystals are completely dissolved, and allowing the pack to slowly cool to room temperature.[16] Preparation A crystal of sodium acetate trihydrate (length 1.7 centimetres) For laboratory use, sodium acetate is inexpensive and usually purchased instead of being synthesized. It is sometimes produced in a laboratory experiment by the reaction of acetic acid, commonly in the 5–8% solution known as vinegar, with sodium carbonate ("washing soda"), sodium bicarbonate ("baking soda"), or sodium hydroxide ("lye", or "caustic soda"). Any of these reactions produce sodium acetate and water. When a sodium and carbonate ion-containing compound is used as the reactant, the carbonate anion from sodium bicarbonate or carbonate, reacts with hydrogen from the carboxyl group (-COOH) in acetic acid, forming carbonic acid. Carbonic acid readily decomposes under normal conditions into gaseous carbon dioxide and water. This is the reaction taking place in the well-known "volcano" that occurs when the household products, baking soda and vinegar, are combined. CH3COOH + NaHCO3 → CH3COONa + H2CO3 H2CO3 → CO2 + H2O Industrially, sodium acetate trihydrate is prepared by reacting acetic acid with sodium hydroxide using water as the solvent. CH3COOH + NaOH → CH3COONa + H2O Structure The crystal structure of anhydrous sodium acetate has been described as alternating sodium-carboxylate and methyl group layers.[17] Sodium acetate trihydrate's structure consists of distorted octahedral coordination at sodium. Adjacent octahedra share edges to form one-dimensional chains. Hydrogen bonding in two dimensions between acetate ions and water of hydration links the chains into a three-dimensional network.[18][19] Comparison of anhydrous and trihydrate crystal structures Degree of hydration Na coordination Strongly bonded aggregation Weakly bonded aggregation Anhydrous[17] 2D sheet sheets stacked withhydrophobic surfaces in contact Trihydrate[18][19] 1D chain chains linked by hydrogen bonds(one chain highlighted in light blue) Reactions Sodium acetate can be used to form an ester with an alkyl halide such as bromoethane: CH3COONa + BrCH2CH3 → CH3COOCH2CH3 + NaBr Sodium acetate undergoes decarboxylation to form methane (CH4) under forcing conditions (pyrolysis in the presence of sodium hydroxide): CH3COONa + NaOH → CH4 + Na2CO3 Calcium oxide is the typical catalyst used for this reaction. Caesium salts also catalyze this reaction.[citation needed] References ^ "Sodium Acetate". International Chemical Safety Cards. 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Hot Ice – Instructions, Pictures, and Videos How Sodium Acetate heating pads work Retrieved from " Today we are going to learn all about oxidation by conducting two science experiments using pennies! 3 dull or dirty looking pennies Small non-metal container with lid Experiment Instructions: Pour the vinegar and salt into the small bowl & stir to dissolve. Put pennies into the bowl for 30 seconds. For very dull pennies soak for 1 minute. Take out pennies & rinse them with water. Place the pennies on a paper towel to dry. Experiment Explanation: Pennies are made of copper or copper & zinc. They look dull or dirty when covered with copper oxide. Copper oxide forms when the copper reacts with oxygen in the air. Vinegar is acetic acid. The acetic acid reacts with the salt (sodium chloride) to produce sodium acetate & hydrogen chloride. These quickly remove the copper oxide from the pennies leaving a pure and shiny metal surface. Experiment Instructions: Place a paper towel or cotton pad in the bottom of the lidded container. Wet the paper towel with a bit of vinegar. Put a penny on the wet pad & cover with the lid. (The lid keeps the vinegar from drying out.) Put a penny on a dry pad or paper towel. (This is your control penny.) Dip a penny in the salt/vinegar mixture and place it on a dry pad or paper towel. Observe your pennies at 1, 2, 3 & 8 hours. Experiment Explanation: Shiny pennies have exposed copper to react with oxygen in the air to form copper oxide making the pennies look dirty again. As the pennies continue to react with the oxygen a green-blue compound called malachite forms. Two of the pennies are exposed to acid; the vinegar and salt mixture you dipped one penny into and the vinegar you put on the cotton pad. These acids speed up the oxidation process. The vinegar (acetic acid) on the pad prevents the copper from oxidizing so the copper stays shiny. Chemistry in Daily Life: The Statue of Liberty is covered with copper. Copper reacts with oxygen to form copper oxide and then malachite. The Statue of Liberty is green because of oxidation. Experiment Tip: Pennies made in 1982 or earlier are made of solid copper, use them in this experiment to make it work even better. Experiment Questions: Which penny oxidized the quickest? Why do you think this happened? Look at the back of the penny on the vinegar pad. What does it look like? Why? Preview Preview These corrosion data are mainly based on results of general corrosion laboratory tests, carried out with pure chemicals and water solutions nearly saturated with air (the corrosion rate can be quite different if the solution is free from oxygen). All concentrations are given in weight-% and the solvent is water if nothing else is shown. The corrosion data apply to annealed materials with normal microstructure and clean surfaces, throughout. Symbol clarification Acetic acid, CH3COOH + sodium chloride, NaCL Conc. CH3COOH, % 1 1 3 4 7 7-10 10 10 25 Conc. NaCL, % 1 5 4 1 5 8.5 5 26 26 Temp. °C 70 50 BP 70-BP 70 80 BP BP BP Grade or type of alloy: Carbon steel 2 13 Cr 2 Sandvik 3R12 0ps 0ps 1ps 1ps 1ps Sandvik 3R60 0ps 0p 0ps 0ps 0ps 0ps 0ps 1ps 1ps 18Cr13Ni3Mo 1) 0ps 0p 0ps 0ps 0ps 0ps 1ps 1ps 17Cr14Ni4Mo 2) 0ps 0p 0ps 0ps 0ps 0ps 0ps 1ps 1ps Sandvik 2RK65 ('904L') 0ps 0p 0ps 0ps 0ps 0ps 0ps 1ps 1ps Sanicro 28 0 0 0 0 0 0 0 0p 0p 254 SMO 0 0 0 0 0 0 0 0 654 SMO 0 0 0 0 0 0 0 0 Sandvik SAF 2304 0 0 0 0p 0 0 0 2 Sandvik SAF 2205 0 0 0 0 0 0 1p Sandvik SAF 2507 0 0 0 0 0 0 0 0 Titanium (CP Ti) 0 0 0 0 0 0 0 0 1) ASTM 317L, e.g. Sandvik 3R642) EN 1.4439, e.g. Sandvik 3R68 These corrosion tables use a number of symbols, having the following meanings: Symbol Description 0 Corrosion rate less than 0.1 mm/year. The material is corrosion proof. 1 Corrosion rate 0.1—1.0 mm/year. The material is not corrosion proof, but useful in certain cases. 2 Corrosion rate over 1.0 mm/year. Serious corrosion. The material is not usable. p, P Risk (severe risk) of pitting and crevice corrosion. c, C Risk (Severe risk) of crevice corrosion. Used when there is a risk of localised corrosion only if crevices are present. Under more severe conditions, when there is also a risk of pitting corrosion, the symbols p or P are used instead. s, S Risk (Severe risk) of stress corrosion cracking. ig Risk of intergranular corrosion. BP Boiling solution. ND No data. (Used only where there are no actual data to estimate the risk of localised corrosion instead of p or s). Disclaimer: Laboratory tests are not strictly comparable with actual service conditions. 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