

Trisodium phosphate

Trisodium phosphate ^[1]			
[[Image:Trisodium phosphate.png		Trisodium phosphate]]	
[[File:Trisodium_phosphate_3D.jpg]]	[[File:Trisodium phosphate hydrate.jpg
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Identifiers			
CAS number	7601-54-9 ^[2] ✓, 10101-89-0 (dodecahydrate)		
PubChem	166757 ^[3]		
ChemSpider	22665 ^[4] ✓		
UNII	J9O85FKF29 ^[5] ✓		
EC number	231-509-8 ^[6]		
KEGG	D09000 ^[7] ✓		
ChEMBL	CHEMBL363100 ^[8] ✓		
RTECS number	TC9575000		
Properties			
Molecular formula	Na ₃ PO ₄		
Molar mass	163.94 g/mol		
Density	1.620 g/cm ³ (dodecahydrate)		
Melting point	73.5 °C decomp. (dodecahydrate)		
Solubility in water	1.5 g/100 mL (0 °C) 8.8 g/100 mL (25 °C)		
Basicity (p <i>K</i> _b)	2.23		
Structure			
Crystal structure	Trigonal		
Hazards			
MSDS	ICSC 1178 ^[9]		
EU Index	Not listed		
NFPA 704			
Flash point	Non-flammable		
Related compounds			
Related compounds	Monosodium phosphate Disodium phosphate Tripotassium phosphate		

<p style="text-align: center;">✓ (what is this?) (verify) ^[10]</p> <p>Except where noted otherwise, data are given for materials in their standard state (at 25 °C, 100 kPa)</p>		
<p style="text-align: center;">Infobox references</p>		

Trisodium phosphate (TSP, E339) is a cleaning agent, food additive, stain remover and degreaser. It is a white, granular or crystalline solid, highly soluble in water producing an alkaline solution. The item of commerce is often partially hydrated and may range from anhydrous trisodium phosphate, Na_3PO_4 , to the dodecahydrate, $\text{Na}_3\text{PO}_4 \cdot 12\text{H}_2\text{O}$. Most often found in white powder form, it can also be called **trisodium orthophosphate** or just plain **sodium phosphate**. Trisodium phosphate was at one time extensively used in formulations for a wide variety of consumer grade soaps and detergents, but ecological problems have largely ended that practice, at least in the western world. Though substitutes are not as effective,^[11] the raw chemical can be bought in bulk for addition to underpowered detergents.^[12]

Uses

Cleaning

The major use for trisodium phosphate is in cleaning agents. The pH of a 1% solution is 12, and the solution is sufficiently alkaline to saponify grease and oils. In combination with surfactants, TSP is an excellent agent for cleaning everything from laundry to concrete driveways. This versatility and low manufacturing price, made TSP the preferred basis for a plethora of cleaning products sold in the mid-20th century. TSP is still sold, and used, as a cleaning agent, but during the late 1960s in the United States, overuse led to a series of ecological problems.

By the end of the 20th century, many products that formerly contained TSP are now manufactured with **TSP Substitutes**, which consist mainly of sodium carbonate along with various admixtures of nonionic surfactants and a limited percentage of sodium phosphates.

TSP is commonly used after cleaning with mineral spirits in order to remove hydrocarbon residues. TSP may be used with household chlorine bleach in the same solution without hazardous reactions.^[13] This mixture is particularly good for removing mildew.

Although it is still the active ingredient in some toilet bowl cleaning tablets, TSP is generally not good for cleaning bathrooms, because it can corrode metal and can damage grout.^[14]

Flux

In the United States, trisodium phosphate is an approved flux for use in hard soldering joints in medical grade copper plumbing. The flux is applied as a concentrated water solution and dissolves copper oxides at the temperature used in copper brazing. Residues are fully water soluble and can be rinsed out of plumbing before it is put in service.

TSP is used as an ingredient in fluxes designed to deoxygenate nonferrous metals for casting.

TSP can be used in ceramic production to lower the flow point of glazes.

Painting enhancement

TSP is still in common use for the cleaning, degreasing and deglossing of walls prior to painting. TSP breaks the gloss of oil based paints and opens the pores of latex based paint providing a surface better suited for the adhesion of the subsequent layer of paint.^[15]

Other

It is an ingredient in General Mills cereals Lucky Charms, Raisin Nut Bran, Honey Nut Cheerios, Cheese Nips, and Great Value's Honey cheerios, etc.

Exercise performance enhancement

TSP has gained a following as a nutritional supplement that can improve certain parameters of exercise performance.^[16] The basis of this belief is the fact that phosphate is required for the energy-producing Krebs cycle central to aerobic metabolism. However, it is generally considered to be a bad idea to ingest compounds that are sufficiently caustic to dissolve cell membranes. Phosphates are available from a number of other sources that are much milder than TSP. While trisodium phosphate is not toxic per se, it is severely irritating to gastric mucosa unless used as part of a buffered solution.

Environmental effects

TSP was once the major component of laundry and dishwashing detergents. However, the phosphate contained in these products was not removed from wastewater during treatment and was then subsequently discharged into watersheds and larger bodies of water. There, phosphate was often the limiting agent for waterborne plant life, and the excess caused algal blooms and subsequent eutrophication of lakes and estuaries. In the United States, the Clean Water Act severely limited the use of phosphates in general, and trisodium phosphate in particular, in consumer cleaning products.

Products sold as TSP substitute, containing soda ash and zeolites, are promoted as a direct substitute. However, sodium carbonate is not as strongly basic as trisodium phosphate, making it less effective in demanding applications. Zeolites are added to laundry detergents as bulking agents that rapidly break down in water and are essentially nonpolluting. Even cleaning products labeled as TSP may contain other ingredients as well, and may, in fact, be less than half trisodium phosphate.^[17]

References

- [1] *Merck Index*, 12th Edition, **8808**.
- [2] <http://www.commonchemistry.org/ChemicalDetail.aspx?ref=7601-54-9>
- [3] <http://pubchem.ncbi.nlm.nih.gov/summary/summary.cgi?cid=166757>
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- [6] <http://ecb.jrc.ec.europa.eu/esis/index.php?GENRE=ECNO&ENTREE=231-509-8>
- [7] <http://www.kegg.jp/entry/D09000>
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- [11] Navarro, Mireya (18 September 2010). "Cleaner for the Environment, Not for the Dishes" (<http://www.nytimes.com/2010/09/19/science/earth/19clean.html>). *The New York Times*. .
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- [14] "TSP ... Cleaning for the Big Dogs" (<http://www.naturalhandyman.com/iip/infxta/infmsp.html>). *Home Repair and Do It Yourself Tips and Articles from the Natural Handyman*. Natural Handyman. .

- [15] "?" (<http://www.naturalhandyman.com/qa/qapaintprep.html>). .
- [16] Folland JP et al. (2008). "Sodium phosphate loading improves laboratory cycling time-trial performance in trained cyclists.". *Journal of Science and Medicine in Sport* **11** (5): 464–468. doi:10.1016/j.jsams.2007.04.004. PMID 17569583.
- [17] MSDS (http://www.dap.com/docs/msds/00079403001_english.pdf) for Dap TSP cleaner

External links

- Safety data from IPCS INCHEM (<http://www.inchem.org/documents/icsc/icsc/eics1178.htm>)
- International Chemical Safety Card 1178 (http://www.ilo.org/legacy/english/protection/safework/cis/products/icsc/dtasht/_icsc11/icsc1178.htm)

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