NATIONAL TRANSPORTATION SAFETY BOARD
Investigative Hearing
Norfolk Southern Railway general merchandise freight train 32N derailment with subsequent hazardous material release and fires, in East Palestine, Ohio, on February 3, 2023

GROUP	D
EXHIBIT	
16	

Agency / Organization

Oxy Vinyls, LP

Title

Oxy Vinyls Response to NTSB Regarding Formation of Acetylides, March 31, 2023

Docket ID: **DCA23HR001**

Stegmann, Karenanne R.

From:	Stegmann, Karenanne R.
Sent:	Friday, March 31, 2023 3:10 PM
To:	Dougherty Marc
Cc:	Payan Ruben; Stancil Paul
Subject:	NTSB Information Request - Oxy Vinyls
Attachments:	McKetta Reference.pdf

Marc,

This email contains Oxy's response to the NTSB question noted below.

Question: Does the presence of aluminum and VCM cause the formation of acetylides?

Response: Oxy does not believe it is possible for aluminum and VCM to result in the formation of acetylides. We have identified an external resource -- the McKetta Encyclopedia of Chemical Processing and Design[1] -- which indicates aluminum is an acceptable material of construction for storage and shipping of VCM. For reference, we have attached pictures of the applicable pages.

Thanks,
Karenanne Stegmann

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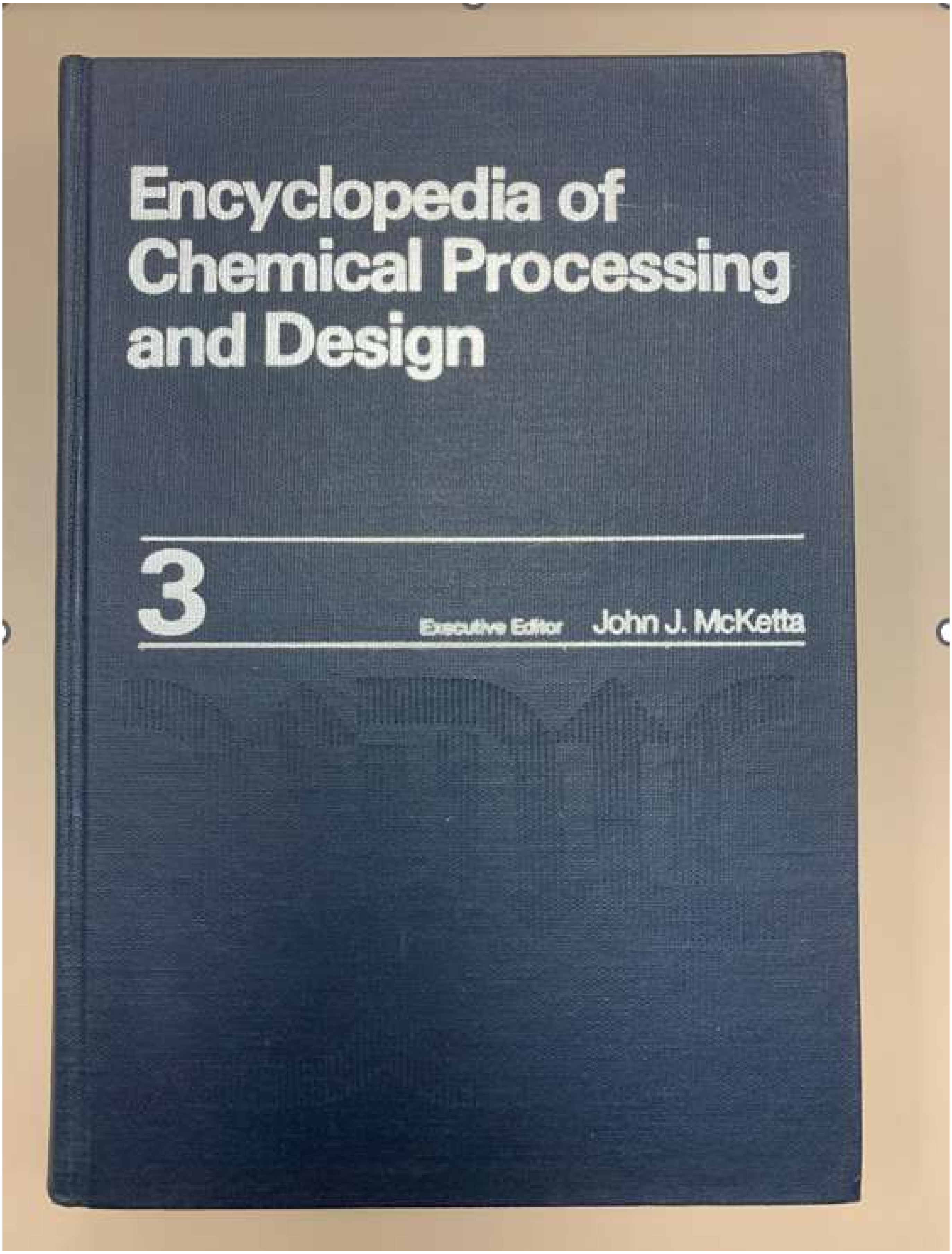
[1] Encyclopedia of Chemical Processing and Design, Volume 3, pp. 79 through 84 inclusive.



Encyclopedia of Chemical Processing and Design

3

Executive Editor John J. McKetta

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These products have been widely used for the design and fabrication of gas liquefaction equipment.

Data regarding the tensile and compressive properties will enable the designer to satisfy static parameters such as pressure, weight, volume, and temperature. However, other considerations must be evaluated. What are the magnitude of cyclic loads? Are the enduring loads such as to raise question regarding creep? The fatigue and creep data for aluminum alloys are listed in Refs. 20 and 31. The design engineer should be sufficiently aware of fabricating processes to appreciate the level of residual, tensile, and compressive stresses [32], their distribution, and the effect on the structure stability. Concern over failure by buckling should include not only when the equipment is on stream but when idle or down during storage, prior to installation, and during shipment [47]. There are too many examples of failure being initiated or occurring during these periods. One example is equipment so mounted for shipment that the load would vibrate and develop fatigue cracks in transit.

All too frequently, materials are selected on the basis of high tensile strength or compressive strength without considering the need of a material to add sufficient ductility. The importance placed on the requirements of ductility by elongation measured in the conventional manner is frequently not helpful for the producing of sound design. Fortunately, fracture mechanics studies have enabled a more scientific approach to ductility. Fracture toughness and tear resistance can be scientifically employed by designers to satisfactorily approach the ductility requirements [33–36]. A term used with ductility should be toughness. An alloy that shows, when highly stressed, crack growth or only slow crack growth proceeding from a flaw in surface with a sharp tip is, in current parlance, said to possess toughness. The data and methods of employing the data regarding fracture mechanics and fracture toughness should receive most careful attention by designers.

There are two kinds of data that can be advantageous in choosing one alloy over the other, providing the other requirements are more or less equal. An alloy having a stress–strain curve [31] which shows a pronounced requirement of marked increase in a load to produce increased extension beyond the linear portion of the data is a desirable characteristic. Obviously, a least desirable alloy from this viewpoint would be one that yields a stress–strain curve beyond the linear portion of the data that requires only slight increases in load to produce large increases in extension. Alloys with a stress–strain curve of the former type are to be preferred to those that have stress–strain curves of the latter type.

Another useful characteristic can be termed uniform elongation; that is, the amount of strain that an alloy can endure before necking (that is, incipient failure). Uniform elongation is a macrodetermination that is one measure of the uniformity of the piece.

The ability of an alloy to relax can be a valuable characteristic since relaxation may reduce locked up or residual stresses [32, 37].

The choosing of alloys for specific applications, the sizes, and the configurations that the alloy is available in is another important consideration. For example, by choosing an alloy that can be extruded in the necessary configurations enables improved heat transfer because the metal can be placed where it can be utilized to the greatest degree without requiring joining or

causing interrupted interfaces. The availability of an alloy in large plates can minimize welding and increase the homogeneity of the structure.

Resistance to Corrosion and Compatibility with Specific Chemicals

Aluminum alloys are used to process, handle, transport, and/or store the chemicals and substances in Table 15.

TABLE 15 Listing of Chemicals Processed in Aluminum Alloy Equipment

Abietic acid
Acetaldehyde
Acetanide
Acetic acid
Acetic anhydride
Acetone
Acetone oil
Acetonitrile
Acetylene
Acetylsalicylic acid
Acrolein
Acrylic acid
Acrylonitrile
Adipic acid
Agar
Air, liquid
Ajonan oil
Albumin
Aldol
Alkyl socium sulfates
Allyl caproate
Allyl isothiocyanate
Almond oil
Alumina
Aluminum acetate
Aluminum formate
Aluminum nitrate
Aluminum stearate
Aluminum sulfate
Aluminum tartrate
Amber oil
2-Aminoethanol
Aminoethylethalamine
Ammonia
Ammonium bicarbonate
Ammonium carbamate
Ammonium carbonate
Ammonium molybdate
Ammonium nitrate
Ammonium perchlorate
Ammonium sulfide
Ammonium thiocyanate
Ammonium thioglycolate
Amyl alcohol
Amyl butyrate
Amyl mercaptan
Amyl nitrate
Amyl nitrite
Amyl silicylate
α-Amylsinnamaldehyde
Amyl valerate
Anethole
Angelica root oil
Angelica seed oil
Angostura oil
Aniline
Anisaldehyde
Anis bark oil
Anise oil
Anisyl acetate
Anisyl alcohol
Anisyl formate
Anthracene
Antifreeze solution
Antimony pentafluoride
Antipyrene
Apple juice
Argon
Arnica oil
Asafetida oil

(continued)

TABLE 15 *(continued)*

2-Heptanol
Heptyl aldehyde
Hexachlorobenzene
Hexachlorocyclohexane
Hexachloroethane
Hexahydrobenzaldehyde
n-Hexane
1-Hexanol
1-Hexyl aldehyde
α,β-Hexylene aldehyde
Hydracrylonitrile
Hydroabietyl alcohol
Hydrocyanic acid
Hydrogen
Hydrogen peroxide
Hydrogen sulfide
Hydroquinone

Isoamyl acetate
Isoamyl propionate
Isobornyl acetate
Isobutane
Isobutyl acetate
Isobutyric acid
Isoeugenol
1-Isofenchyl alcohol
Isooctanoic acid
Isoprene
Isopropyl acetate
Isopropyl alcohol
Isopulegol
Itaconic

Juniper oil
Juniper tar

Kaolin
Kerosene
Ketones

Latex
Lauric acid
Lemon grass oil
Limettin
Limonene
Lindane
Linoleic acid
Linolenic acid
Linseed oil
Lithopone

Madder lake
1-Malic acid
Maple syrup
Margarine
Methacrylic acid
Methane
Methenamine
Methyl acetate
Methyl alcohol
Methylbenzaldehyde
Methyl ethyl ketone
Methyl formate
Methyl ether
Methyl glycerol
Methylheptylacetaldehyde
Methylhydrazine
Methyl isobutyl ketone
Methyl methacrylate
Methylphenylpyrazolone
Methyl salicylate
Milk
Monoethanolamine
Monacetin
Montan wax
Mustard oil

Naphtha
Naphthalene
Naphthalic acid
Naphthenic acid
Natural gas
Naval store
Neon
Nerolidol
Nicotine
Nitric acid
Nitroaniline
Nitrobenzolylchloride
2-Nitro-1-butanol
Nitrocellulose
Nitroethane
2-Nitro-2-ethyl-1,3-propanediol
Nitrofurazone
Nitrogen
Nitroglycerin
Nitromethane
Nitroparaffins
Nitrophenol
Nitropanes
Nitrotoluenes

(continued)

TABLE 15 *(continued)*

n-Nonyl alcohol
Nylon

Oenanthic acid
Oleic acid
Olive oil
Oxogluconic acid
Oxygen
Ozone

Palmitic acid
Palm oil
Paraffin
Paraformaldehyde
Paraldehyde
Parathion
Peanut oil
Pectin
Penicillin
Pentacythritol
Pentaerythrityl tetranitrate
Peppermint oil
Peracetic acid
Phenol
Phenyl ether
2-Phenyl-2-propanol
Phosphor suspensions
Phosphorus
Phthalic acid
Phthalic anhydride
Picolines
Picric acid
Pinene
Pine oil
Piperazine
Polyethylene
Polyphenylisocyanate
Polypropylene
Polystyrene
Polystyrene sulfonates
Polyvinyl acetate
Polyvinyl alcohol
Polyvinyl butyral resins
Polyvinyl chloride
Potassium ferricynide
Potassium nitrate
Potassium nitrite
Potassium pyrosulfate
Potassium sulfate
Potassium thiocyanate

Propane
Propionic acid
Propionic aldehyde
Propionic anhydride
Propyl acetate
Propylene glycol
Pyridine

Quinoline

Ricinoleic acid

Salicylic acid
Santonin
Sewage
Sodium acetate
Sodium azide
Sodium benzenesulfonate
Sodium bicarbonate
Sodium lauryl sulfate
Sodium percarbonate
Sodium perchlorate
Sodium propionate
Sorbitol
Sorbose
Soya oil
Starch
Stearic acid
Steam
Steptomycin
Sucrose
Sugar
Sulfur

Tall oil
Tallow
Tartaric acid
Terpenes
Terpineol
Tetrachloroethylene
Toluene
Toluene diisocyanate
Tolylacetaldehyde
Toxaphene
Triacetin
Tri-*o*-cresyl phosphate
Tridecanone
Triethanolamine
1,2,4-Trimethylbenzene
2,4,6-Trinitrotoluene

(continued)

TABLE 15 *(continued)*

Tristearin
Tung oil
Turpentine

Undecylenic acid
Uranium hexafluoride
Urea

Vanillin
Veratraldehyde

Vinyl acetate
Vinyl chloride
Vinyl resins

Water
Whale oil

Xanthotoxin
Xenon
Xylene

References 21, 22, and 38–43 include data on many chemicals that have been subjected to laboratory testing in contact with aluminum and aluminum alloys. Aluminum alloys were found resistant to many of these chemicals; hence consideration should be given to the employment of aluminum alloys for equipment to handle and process these substances.

The aluminum alloys listed in Table 9 show remarkable resistance to the effects of industrial, chemical, and sea coast atmospheres. Aluminum alloy products, such as tread plate, hand rails, ladders, and fences, resist the atmospheres existing around most refineries and process plants, and they can frequently reduce maintenance costs.

Aluminum alloys are also often used because aluminum pickup does not discolor or harmfully contaminate the product.

Another advantage of aluminum alloys is their low densities. By the use of aluminum tankage in barges, the carrying capacity has been increaed without increasing displacement or draft.

The presence of trace substance plays an important role in the determination of whether a metal is highly resistant. For example, a trace of water prevents the violent attack of boiling acetic acid that occurs if the water is not present. In this case, the water is an effective inhibitor, whereas if traces of water are present in halogenated hydrocarbons, hydrolysis may occur, producing halogenic acids which are corrosive to many metals including aluminum alloys.

The choice of an alloy for specific process or service must consider temperature conditions from a number of viewpoints. The effects of prolonged exposure on the mechanical properties and characteristics such as tensile and compressive properties, fracture toughness, creep resistance, and sometimes even fatigue properties must be given fufficient consideration. A spectacular use of aluminum alloys was the use of alloy 2219 for liquid oxygen and liquid hydrogen tankage in the space vehicles of the Apollo program [44]. The fact that 2219 is readily weldable was an important factor in its choice, but also the fact that 2219 alloy, in common with other aluminum alloys, is not embrittled at low temperature, was an important requirement.

The aluminum-magnesium alloys are considered standard for the fabrication of equipment to store, handle, and transport liquefied products because of the excellent weldability of these alloys and also because of their excellent mechanical properties and toughness at cryogenic temperatures. In Table 9 the wrought alloys have not been listed in the usual order, but rather in order of their increasing magnesium content. This order was employed because in most of these alloys the greater part of the magnesium is in solid solution [45]. These solid solutions are supersaturated with respect to the magnesium soluble at equilibrium at room temperature. Hence reheating some of these alloys between 150 and 375°F for long periods of time can cause sufficient formation of aluminum-magnesium constituent, preferentially along the grain boundries, to have the alloy become susceptible to either stress corrosion cracking or exfoliation [46]. Heating above 400°F results in both re-solution and the random distribution of any remaining aluminum-magnesium constituent through the grain body. In this condition the alloy is resistant to both types of corrosion.

Table 16 is a highly condensed summary of the available data on the effect of reheating on the resistance to corrosion of some of the tempers of the aluminum-magnesium alloys [48]. It is recommended that these tempers of these alloys not be used for service that requires prolonged heating at temperatures that the data of Table 16 would indicate possible harmful effects. The summation of the time periods of interrupted heating are equal to the total time of prolonged heating. The guidelines from Ref. 48 is to provide in the design of the equipment for occasional periods of reheating for 0.5 h at 550°F in order to cause re-solution of the aluminum-magnesium constituent.

TABLE 16 Effect of Reheating on the Resistance of Aluminum-Magnesium Alloys to Stress Corrosion Cracking and Exfoliation

Mg Content	Alloy	Reheat						
		Time (years)	Temperature (°F)					
			125	150	180	200	250	300
2.5	5052–F	12	—	R[a]	—	R	R	—
2.7	5454–0	8	R	R	R	R	R	R
2.7	5454–H34	8	R	R	R	R	R	R
3.5	5154–0	2	—	—	—	—	S[b]	—
3.5	5154–H34	4	—	—	S	S	S	S
3.5	5154–F	12	—	S	—	S	S	S
4.0	5086–0	4	—	R	—	—	—	—
4.0	5086–H–17	1/6 to 1/4	—	S	—	—	—	—
4.5	5083–0	4	—	R	—	—	—	—
5.1	5456–0	4	—	R	—	—	—	—
5.1	5456–H117	1/6 to 1/4	—	S	—	—	—	—

[a] Indicates resistant to both stress corrosion cracking and to exfoliation before and after heating.

[b] Indicates resistant to both stress corrosion cracking and to exfoliation before heating but susceptible to either or both types of attack after heating.