



ASCEND

PERFORMANCE MATERIALS

Flexatrac-AGS-100
Product Stewardship Summary
April 12, 2017

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Flexatrac-AGS-100 Product Stewardship Summary

Chemical Family: Organic Diacids in Water

Component Acids

Chemical Name:

Synonyms:

CAS. Number:

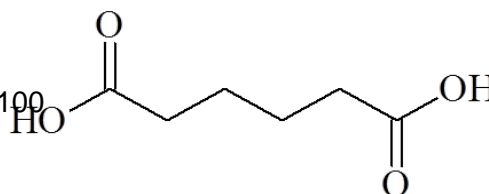
Formula:

Hexanedioic acid

Adipic Acid; A in Flexatrac-AGS-100

124-04-9

$\text{HOOC}(\text{CH}_2)_4\text{COOH}$



Chemical Name:

Synonyms:

CAS. Number:

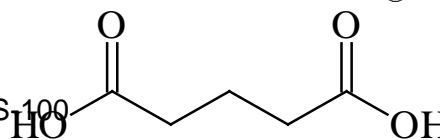
Formula:

Pentanedioic acid

Glutaric Acid; G in Flexatrac-AGS-100

110-94-1

$\text{HOOC}(\text{CH}_2)_3\text{COOH}$



Chemical Name:

Synonyms:

CAS. Number:

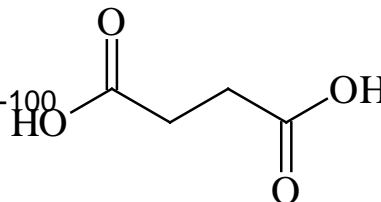
Formula:

Butanedioic acid

Succinic Acid; S in Flexatrac-AGS-100

110-15-6

$\text{HOOC}(\text{CH}_2)_2\text{COOH}$



Introduction

Flexatrac-AGS-100 is a combination of Adipic, Glutaric and Succinic acids. It is manufactured at Ascend's Cantonment, Florida location. It is produced by the nitric acid oxidation of cyclohexanol and cyclohexanone. In this reaction, intended to produce Adipic Acid, a relatively small percentage of Glutaric and Succinic Acids are produced.

Conclusion of Safety for Use

Flexatrac-AGS-100 is safe for industrial use, when used with proper care and responsibly. This includes adherence to Safety Data Sheet and labeling guidance, along with good industrial hygiene, process safety and waste disposal practices. It is up to the customer to determine fitness for use in their facility, handling systems, reaction processes and in their formulated products. Instructions on the MSDS should be followed, and local rules/regulations for waste disposal, vessel/truck cleanout and regulatory notification should be consulted prior to use and disposal of this product.

Uses for Flexatrac-AGS-100

Flexatrac-AGS-100 is used in a variety of ways, including:

Flue Gas Desulfurization

Flexatrac-AGS-100 improves the efficiency of limestone scrubbing systems by buffering the pH of the limestone slurry system. Flexatrac-AGS-100 promotes the efficient removal of SO₂ from flue gases prior to discharge in permitted power generation facilities. This well documented effect can help power generators to economically comply with permit limits, and may allow the use of higher sulfur coal, while providing a potentially valuable byproduct (gypsum) to the user.

Use as an Industrial Intermediate:

Flexatrac-AGS-100 is reacted with other chemicals to form solvents, lubricants, plasticizers and other chemical products. The acid groups on each end of the molecules may undergo esterification, reduction or amidization:

- Dimethyl Esters – Solvent used in industrial reactions, and in consumer paint and caulk strippers
- Bis(2-ethylhexyl) Esters (Dioctyl Esters) – Plasticizers used in PVC films, and a components of hydraulic fluids
- 1,n-Mixed Diols – Monomers used in the manufacture of polyurethanes and polyesters
- Amidization – Intermediate chemicals formed by the reaction of the Flexatrac-AGS-100 with various amines for diamides

Use as a Monomer:

Flexatrac-AGS-100 may be used as a monomer in formation of various polymers. These include

- Nylon Polymers – The reaction product of Flexatrac-AGS-100 Acids and 1,6-Hexamethylenediamine. The resultant polymer would be a mixture of Nylon 6,4, 6,5 and 6,6.
- Polyesters – Such as Poly(1,4-Butylene Adipate) – The reaction products between Flexatrac-AGS-100 Adipic and various Di-Alcohols
- Other polymers, such as Nylon copolymers, and Wet Strength Resins for paper manufacture

Properties of Flexatrac-AGS-100

Commercially, Flexatrac-AGS-100 is available as a ca. 50% solution in water. Typical composition of Flexatrac-AGS-100 is:

Components	Typical Concentration	
Adipic acid	>=6.0 -<=10.0	%
Glutaric acid	>=27.0 -<=35.0	%
Succinic acid	>=9.0 -<=13.0	%
Nitric acid	>=0.0 -<=1.0	%
Dissolved metals	< 500	ppm
Water	>=48.0 -<= 52	%

The acids which are present in Flexatrac-AGS-100 are of varying solubility in water and melting point. Adipic Acid is the least water soluble of the group; Glutaric Acid is the most soluble. Succinic has the highest melting point; Glutaric Acid has the lowest melting point.

Component	Water Solubility at 20°C (77°F)	Water Solubility at 100°C (212°F)	Melting Point
Adipic Acid	2.3% 23 grams/liter 0.19 pounds/gallon	290% 2900 grams/liter 24.2 pounds/gallon	151°C (304°F)
Glutaric Acid	43% 430 grams/liter 3.6 pounds/gallon	Not Measured; Available data at 65°C (149°F) is 1118 grams/liter	97°C (207°F)
Succinic Acid	5.8% 58 grams/liter 0.48 pounds/gallon	No data	187°C (368°F)
Nitric Acid	Infinite		-42°C (-43°F)

Chemical Properties

Available chemical information is below. This data is a combination of Ascend data, and publically available data.

Parameter	Available Data
Appearance:	Yellow to Yellow-Green Liquid
pH:	1-2 (50% solution in water)
Freeze Point:	40°C (104°F) – Adipic Acid loses sufficient solubility at this temperature, and separates from the mixture.
Flash Point:	210°C (410°F) Cleveland open cup
Flammability:	Nonflammable as received; dried material may burn
Explosive Properties:	Non explosive
Vapor Pressure:	Not measured on Ascend's Flexatrac-AGS-100; A literature study of a typical sample of anhydrous product (27% Adipic, 40% Glutaric, 31% Succinic) showed a measured vapor pressure of 1.12hPa (0.016 psi). Vapor analysis shows that the volatile material is weighted to the lower molecular weight component (Succinic Acid)
Specific Gravity	1.12
Viscosity:	4 centipoise at 65°C (149°F)

Vapor Composition

Flexatrac-AGS-100 has an odor, especially at elevated temperatures. While the composition of Flexatrac-AGS-100 primarily is the water solution of the acids mentioned above, there are some low level impurities which are responsible for the smell. The major acids (Adipic, Glutaric and Succinic) are of low vapor pressure, and do not contribute significantly to odor. The impurities, however, are acid molecules which do have some volatility, and also have very low odor thresholds. Most people are able to detect the smell in air.

While these mono-acid molecules are at parts per million levels in the Flexatrac-AGS-100 product, their volatility and odor characteristics make them easily detected when Flexatrac-AGS-100 is at elevated temperatures. For these materials, the odor thresholds are much lower than any occupational concern levels. Acetic acid is the most familiar of these; the remaining ones are present in many biological processes, and are partially responsible for human body odor, the smell of rotting meat and decaying dairy products, and the aroma of aged cheese.

The acids which are present at low levels are:

Common Name	CAS Name	CAS Number	Odor Threshold ¹		Occupational Exposure Limit	Odor Description ²
			ppb	µg/m3		
Acetic Acid	Ethanoic Acid	64-19-7	5.2	12.7	10 ppm (OSHA PEL)	Pungent, Vinegar
Propionic Acid	Propanoic Acid	79-09-4			10 ppm (NIOSH REL)	Pungent, Fecal
Butyric Acid	Butanoic Acid	107-92-6	0.26	0.95	None Available	Rancid Butter
Valeric Acid	Pentanoic Acid	109-52-4			None Available	Fecal, Sweaty
Caproic Acid	Hexanoic Acid	142-62-1	1.0	4.9	None Available	Sharp, sour, rancid

Combustion Products

Flexatrac-AGS-100 as sold will not burn. If the 50% water in the product were to evaporate, Flexatrac-AGS-100 could become combustible. When anhydrous Flexatrac-AGS-100 is burned in an excess oxygen environment, typical combustion products should include Carbon Dioxide, Carbon Monoxide, and Water. In limited oxygen or fires involving other chemicals, combustion products could include low weight aldehydes (such as Formaldehyde, Acetaldehyde).

Physical Properties

As mentioned above, Adipic Acid is the least soluble of the acids. If Flexatrac-AGS-100's storage or use temperature drops below 40°C, Adipic will begin to precipitate from the mixture. This precipitation can build within handling systems, resulting in pluggage and performance loss. Adipic can be re-dissolved into the Flexatrac-AGS-100 with increased heat, or can be rinsed from the handling system with warm or hot water.

When Flexatrac-AGS-100 is used at a low level in a large liquid system (such as in Flue Gas Desulfurization), the solubility of Adipic Acid is not a concern.

Health Affects Overview

Flexatrac-AGS-100 and its components have been extensively studied by manufacturers, governmental agencies and researchers around the world. The studies which have been conducted show that:

- Flexatrac-AGS-100 is safe for use in an industrial setting by trained workers, in the manner intended.
- Flexatrac-AGS-100 does not pose unmanageable occupational risks when properly controlled through engineering and protective equipment.
- Flexatrac-AGS-100 has been shown to be virtually non-toxic via oral or skin exposure. While Flexatrac-AGS-100 itself has never been tested for inhalation toxicity, two of its component acids have been, and have been shown to be virtually non-toxic.
- Flexatrac-AGS-100 is not a skin sensitizer.
- While Flexatrac-AGS-100 has had one positive high dose mutagenicity study, many others have been negative. The overall evidence for Flexatrac-AGS-100, and its component acids, is that Flexatrac-AGS-100 is non-mutagenic
- Flexatrac-AGS-100 has never been tested for cancer, but one of its three component acids (Adipic Acid) has had negative cancer studies.
- Like most acidic materials, if Flexatrac-AGS-100 gets into the eyes, it can cause severe irritation. If left untreated, eye damage may occur. Opportunity for these effects can be minimized through good industrial practice and personal protective equipment. The severity of these effects can be reduced through eye washing and proper medical follow-up.

- Especially at elevated temperatures, Flexatrac-AGS-100 has a smell which many find objectionable. This odor is due to low levels of mono carboxylic acids. While their odor is not pleasant, the level of these impurities is not at a level which is of a health concern.

Established Occupational Exposure Limits

There are no occupational limits established for Flexatrac-AGS-100 as a blend. In many jurisdictions, occupational exposure limits have been established for the component Acids. These are limits above which it is deemed necessary to have employees protected from inhalation exposure. The current established limits for the individual acids are:

Jurisdiction	Adipic	Glutaric	Succinic	Nitric
ACGIH TLV:	5 mg/m ³ (8 Hour TWA)	None established in any jurisdiction		2 ppm (8 Hour TWA)
OSHA PEL:				5 mg/m ³ (8 Hour TWA)

While there are no governmental exposure limits for Flexatrac-AGS-100, recently a consortium of companies registered Flexatrac-AGS-100 for continued use in Europe. In this registration, the European manufacturers of Flexatrac-AGS-100 are required to prove that under typical use conditions, Flexatrac-AGS-100 is safe for its intended use. The registrants are required to provide methodically derived values for no-effect levels. These levels, developed according to the European Chemical Agency's Chemical Safety Assessment Methodology³, reflect the level of exposure which is thought to be without risk of a health effect. These levels are shown below, and should be used by an Industrial Hygiene professional in assessing workplace exposure to Flexatrac-AGS-100. The inhalation values derived by this methodology match the ACGIH TLV value for Adipic Acid; either should be considered to be a protective threshold for industrial exposure.

Route of Exposure	Duration of Exposure	Type of Effect	Derived No Effect Level
Dermal	Acute (< 15 minutes)	Systemic Effects	5 mg/kg of bodyweight/day
Dermal	Long Term (8-10 hours per day)	Systemic Effects	5 mg/kg of bodyweight/day
Inhalation	Acute (< 15 minutes)	Systemic Effects	34 mg/m ³
Inhalation	Acute (< 15 minutes)	Local Effects (irritation)	5 mg/m ³
Inhalation	Long Term (8-10 hours per day)	Local Effects (irritation)	5 mg/m ³

Details on Health Effects

Acute Effects

In the workplace, acute effects from Flexatrac-AGS-100 exposure may occur via splash exposure to the eyes, skin, or inhalation of mist. While Flexatrac-AGS-100 on the skin could lead to irritation and staining, the likelihood of effects is low and effects can be eliminated through removal of the product from the skin. Much of the data which is presented here is sourced from the 2012 REACH registration for Flexatrac-AGS-100. This data is sourced from a consortium of major European producers of Flexatrac-AGS-100, and represented the most reliable data for each category.

Oral Toxicity – Flexatrac-AGS-100 was tested for oral toxicity by Ascend, with an LD50 value of >5.000 mg/kg. The REACH consortium reported an LD50 value of 6000 mg/kg. Flexatrac-AGS-100 is classified as practically non-toxic by mouth (OSHA Hazcom standard) and not classifiable (GHS)

Inhalation Toxicity – Flexatrac-AGS-100 has not been tested for inhalation toxicity. It is provided by Ascend as a liquid solution in water, and it is possible that mist exposure could be a workplace concern. The acids are of such low vapor pressure that vapor exposure is not a concern.

The Flexatrac-AGS-100 REACH consortium reported read across data for Adipic Acid dust. This data showed that Adipic is classified as non-toxic by inhalation. In animal studies, the LC₅₀ (rat) value for Adipic is 7700 mg Adipic/m³ of air. This level is far above relevant occupation exposure limits (please see table above). While it is non-toxic by inhalation, the inhalation of any powder, including solid Flexatrac-AGS-100, or the inhalation of Flexatrac-AGS-100 mist, can be irritating to the nasal and bronchial tracts, and to the lungs.

It is possible that if Flexatrac-AGS-100 is heated above 70-75°C (160-167°F) for extended periods of time, low levels of nitrogen oxides may form and off-gas from the product. These are harmful if inhaled.

Dermal Toxicity – An Ascend sponsored study found Flexatrac-AGS-100 to have a dermal LD50 value of >7940 mg/kg. At the highest dose level (7940 mg/kg) no animal deaths occurred. This value fits with the consensus values for two of the individual acids, >7940 (Adipic), >10,000 mg/kg (Glutaric)⁴. Flexatrac-AGS-100 is classified as non-toxic by skin exposure (OSHA Hazcom standard) and not classifiable (GHS)

Dermal Irritation – Flexatrac-AGS-100 was tested and found to be non-irritating to rabbit skin. It is classified as non-irritating (OSHA Hazcom Standard) and not classifiable (GHS).

Eye Irritation – Flexatrac-AGS-100, and its individual acids, is severely irritating to the eyes – it will cause redness, pain and tearing. If left in the eyes for an extended period of time, it can cause damage to the cornea. This is based on both animal studies and on occupational experience. Animal studies by Ascend and others have shown that Flexatrac-AGS-100 eye exposure will result in non-reversible changes to the eye, including clouding of the cornea and ulceration of the cornea and mucosal areas of the eyelids.

Flexatrac-AGS-100 acids are soluble in water; if Flexatrac-AGS-100 lands on the surface of the eye, it will dissolve into the tear film present on the surface of the eye, and will lower the pH of the film. The phenomenon occurs with almost any acidic material. When this pH is lowered changes occur in proteins present on the cornea, and in the skin inside the eyelids. This results in the effects mentioned above – redness and pain. The human body produces tears in a defensive effort to remove the material from the eye. If Flexatrac-AGS-100 (or any acid) is removed quickly and thoroughly, irritation or damage is minimized, and the effects are easily reversed.

Chronic Effects

Just as for acute exposures, chronic effects from Flexatrac-AGS-100 exposure could occur primarily via mist or liquid exposure.

Sensitization – In animal studies, Flexatrac-AGS-100, and the individual acids, has been shown to not be a sensitizer. No occupational evidence for sensitization has been found.

Oral Exposure – Long term animal feeding studies have shown that after 90 days of daily ingestion of Flexatrac-AGS-100, no effects were seen at dosages of 3% in food (NOAEL = 195 mg Flexatrac-AGS-100/kg of body weight per day). At levels higher than this (10 and 30% in food) the primary effects seen were slightly reduced body weight as compared to control, and decreases in urine pH. No Flexatrac-AGS-100 related effects were seen at necropsy of the

animals. In dietary studies of acids, reduced bodyweight is primarily due to loss of appetite in the test animals. Such high dose levels are not representative of any occupational or environmental exposure.

Inhalation Exposure – No repeat dose studies exist for Flexatrac-AGS-100 inhalation. Based on its toxicity profile and product use profile, these have never been justified.

Cancer – Flexatrac-AGS-100 has not been tested for cancer in animals. Several studies have shown that Adipic Acid does not cause cancer in lab animals, and does not cause genetic mutations in bacteria or animal cells.

Several studies have been conducted on Flexatrac-AGS-100 for mutagenic activity in bacteria and animal cells. The data from these studies is equivocal; most studies have been negative (Ames, mammalian gene forward assay, chromosomal aberration in vivo), positive results were seen in an in vitro chromosome aberration test, but only with metabolic activation, and at a high dose level.

Reproductive/Developmental Effects – No reproductive or developmental data exists for Flexatrac-AGS-100, but does exist for the component acids. Available animal studies for Adipic and Succinic Acids show no effects to reproductive organs or ability for rats, and also no effects to offspring from multiple species of animals.

Environmental Effects Overview

Flexatrac-AGS-100 and its component acids have been extensively studied by manufacturers, governmental agencies and researchers around the world. Hundreds of studies have been conducted, and these studies have shown that:

- Flexatrac-AGS-100 is not Persistent, Bioaccumulative or Toxic in the environment.
- Flexatrac-AGS-100 is readily and inherently biodegradable in water and soil environments.
- Flexatrac-AGS-100 is readily broken down in both aerobic and septic waste disposal systems
- While Flexatrac-AGS-100 shows low or moderate toxicity to aquatic in laboratory studies, these are not reflective of real world conditions. Flexatrac-AGS-100 is a weak acid, and lowers the pH of water. These toxic effects seen in these studies are negated when the pH of the test medium is adjusted back to an environmentally relevant level. Further explanation is below.
- Flexatrac-AGS-100 undergoes photo and chemical degradation.
- Ultimate chemical and biodegradation products are carbon dioxide and water.

Details on Environmental Effects

Flexatrac-AGS-100's primary uses do not result in substantial, untreated releases into the environment. In most cases Flexatrac-AGS-100 is either a small part of a large mixture (such as in Flue Gas Desulfurization) or is reacted in a closed process to form a new chemical substance. Proper use and disposal practices will minimize releases to the environment from all uses of Flexatrac-AGS-100. The data cited below are found in the REACH registration documents for Flexatrac-AGS-100⁵ or the individual acids⁶.

Biodegradation

Flexatrac-AGS-100 has been shown to be readily biodegradable in aerobic and freshwater conditions in lab studies. Data shows that Flexatrac-AGS-100 is 99% degraded within 7 days. Flexatrac-AGS-100 acids can also undergo both photo- and chemical- degradation. When broken down, Flexatrac-AGS-100 Acids are converted into carbon dioxide and water by microorganisms present in the environment.

Microbial degradation is complete meaning that Flexatrac-AGS-100 and intermediate compounds which are formed during the Flexatrac-AGS-100 degradation reaction do not persist in the environment.

Aquatic Toxicity

The acute and chronic toxicity of both Flexatrac-AGS-100 and its component acids to aquatic organisms has been extensively studied. It has been concluded that through normal use, disposal and waste treatment, Flexatrac-AGS-100 should not adversely affect freshwater or marine organisms. As with any acid, if Flexatrac-AGS-100 is placed in a pure water environment, it will lower the pH of the water. Any organisms which are in the water will be affected by such a pH change. Aquatic toxicity data for Flexatrac-AGS-100 is shown below. While all data is pH uncontrolled, in similar studies for Adipic Acid, pH controlled studies show much lower toxicity. pH controlled data is more relevant to waste treatment and small releases, while pH not controlled studies are more relevant to immediate, local effects from large spills and uncontrolled releases.

In addition to Flexatrac-AGS-100 specific studies, the issue of pH control and aquatic toxicity has been thoroughly reviewed in published articles⁷. Studies have shown that a pH change of 3-4 units will be fatal to 50% or more of organisms which are present in the water.⁸

If a large spill of Flexatrac-AGS-100 was to occur, and this spilled material would enter surface water, clearly there would be acute toxic effects. It is for this reason that in the United States, any spill of Adipic Acid in excess of 5000 pounds requires a 24 hour notice to the National Response Center. This quantity is in excess of the amount of Flexatrac-AGS-100 which is in one tanker truck, but is relevant for storage tanks. Flexatrac-AGS-100, when properly controlled and treated, poses no hazard to the aquatic environment.

Fish Toxicity – Flexatrac-AGS-100 and its component acids have been tested with Rainbow Trout, Bluegill Sunfish, and Ide. These results are shown below, and show that neutralization results in a much lower level of aquatic toxicity.

Test	Species	Result	Other notes
96 h LC50 Fish – Flexatrac-AGS-100	Lepomis macrochirus	340 mg/L	Not pH controlled – Range 3.7 to 7.4
96 h LC50 Fish – Flexatrac-AGS-100	Oncorhynchus mykiss	240 mg/L	Not pH controlled – Range 3.8 to 7.0
96 h LC50 Fish – Flexatrac-AGS-100	Leuciscus idus	>147 <215 mg/L	Not pH controlled - Range from 3.8 to 7.8
96 h LC50 Fish – Adipic Acid	Leuciscus idus	230 mg/L	Not pH controlled - Range from 3.8 to 7.8
48 Hour LC50 Fish – Adipic Acid	Leuciscus idus	>1000 mg/L	pH Controlled to neutral; no deaths
96 h LC50 Fish – Adipic Acid	Danio rerio	>1000 mg/L	pH Controlled to neutral; no deaths

Invertebrate Toxicity – Flexatrac-AGS-100 and its component acids have been tested for toxicity with Daphnia Magna. These results are shown below, and again show that any effects are greatly diminished when pH is neutral.

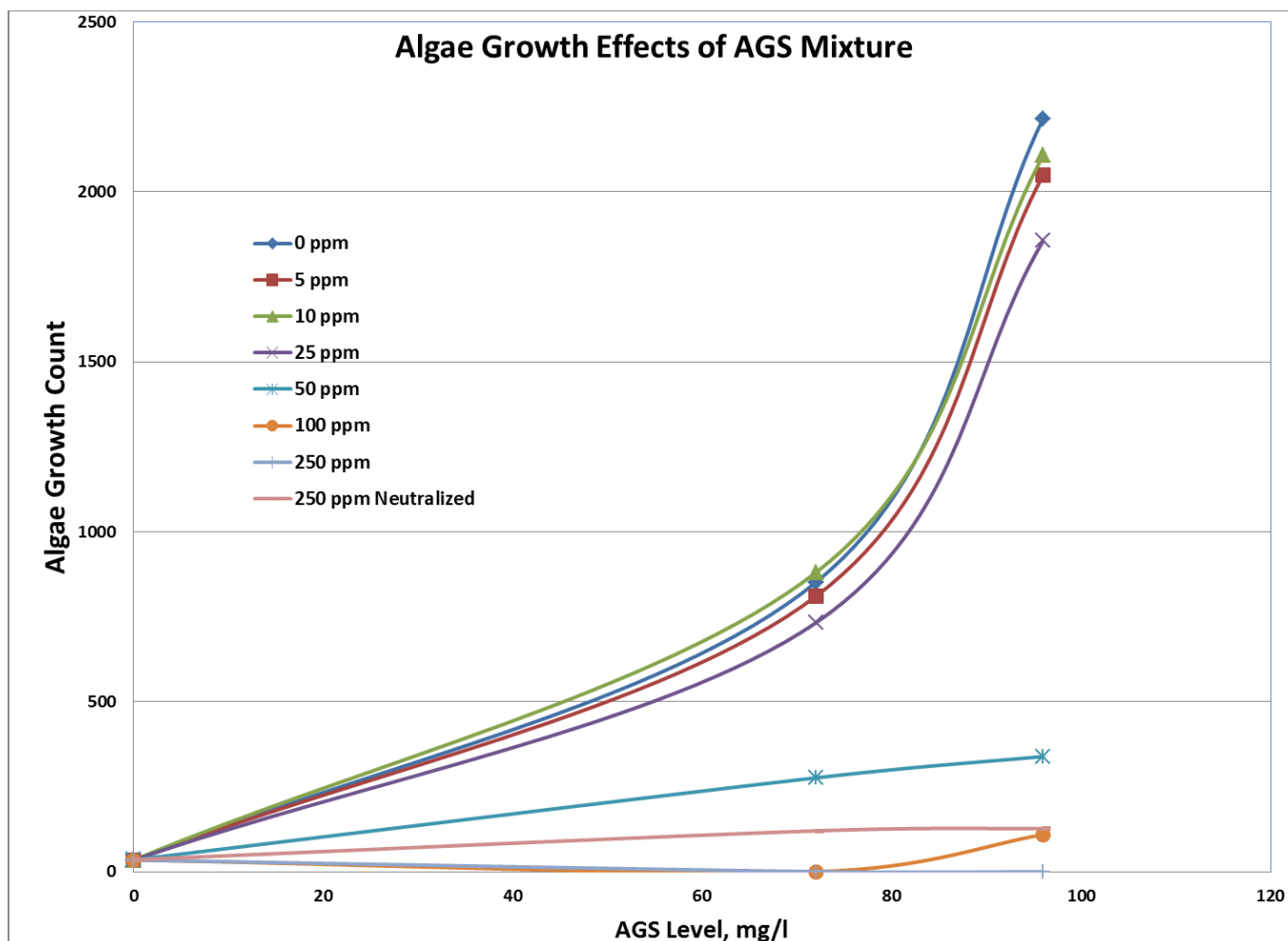
Test	Species	Result	Other notes
48 Hour EC50 – Flexatrac-AGS-100	Daphnia magna	88.39 mg/L	Not pH controlled
48 Hour EC50 – Succinic Acid	Daphnia magna	127 mg/L	Not pH controlled
48 Hour EC50 – Glutaric Acid	Daphnia magna	374 mg/L	Not pH controlled
48 Hour EC50 – Adipic Acid	Daphnia magna	46 mg/L	Not pH controlled
48 Hour EC50 – Adipic Acid	Daphnia magna	85.7 mg/L	Not pH controlled
48 Hour EC50 – Flexatrac-AGS-100	Daphnia magna	> 1000 mg/L	pH Controlled to neutral; no deaths

Algae Toxicity – Flexatrac-AGS-100 and its component acids have been tested for toxicity with various species of algae.

Test	Species	Result	Other notes
72 Hour ErC50 – Flexatrac-AGS-100	Scenedesmus subspicatus	41.9 mg/L	Not pH controlled
96 Hour EC50 – Flexatrac-AGS-100	Desmodesmus subspicatus	35 mg/L	Not pH controlled
96 h EC50 – Succinic Acid	Spirulina labyrinthiformis	120 mg/L	Unknown pH control
72 Hour EC50 – Glutaric Acid	Nitzschia closterium	264 mg/L	Unknown pH control
40h-IC50 Growth Inhibition Test – Adipic Acid	Tetrahymena pyriformis	591 mg/L	Unknown pH control
96 h EC50 Algae Growth Inhibition– Adipic Acid	Desmodesmus subspicatus	26.6 mg/L	Unknown pH control
72 h EC50 Algae Growth Inhibition– Adipic Acid	Pseudokirchnerella subcapitata	59 mg/L	Unknown pH control
72 h EC50 Algae Growth Inhibition– Adipic Acid	Desmodesmus subspicatus	31.3 mg/L	Unknown pH control

In the first test mentioned above, of Flexatrac-AGS-100 with Scenedesmus subspicatus, in addition to the standard range of concentrations, a neutralized sample of Flexatrac-AGS-100 (250

mg/L) was also tested. While an EC50 cannot be determined from this single concentration, it is of note that the toxicity of the neutralized material was less than the toxicity of 100 mg/L Flexatrac-AGS-100. This data is shown below.



Chronic Aquatic Toxicity – Flexatrac-AGS-100 has not been tested for long term aquatic toxicity, but one of the component acids, Adipic Acid, has been tested for long term exposure to *Daphnia Magna*. In this study, no effects were seen at 6.3 mg/L, and the EC50 value was 18 mg/L

Wastewater Treatment Facilities

Based on the inherent biodegradation of Flexatrac-AGS-100, no negative effects on wastewater treatment processes are expected from normal use and disposal. In one activated sludge study of and Adipic Acid rich sample of Flexatrac-AGS-100, the EC50 value was found to be 7910 mg/L.

If a large quantity were to be released to a waste treatment system within a short period of time, some temporary upset to the system may occur, as the Flexatrac-AGS-100 has the potential to lower the pH in the system. Flexatrac-AGS-100 acids, as used in flue gas processes, is very dilute, and should exist as Sodium or Calcium salts; these salts should have no effect on wastewater treatment systems.

Using Flexatrac-AGS-100 – Compatible Materials

Flexatrac-AGS-100 is an acidic material, and handling systems should be properly designed. Studies have determined that the following materials are compatible with Flexatrac-AGS-100 for routine service. A licensed engineer should specify and design any Flexatrac-AGS-100 handling system.

Metals	
Material	Recommendation
Carbon Steel	Unsatisfactory
304L	Satisfactory
316L	Satisfactory
I600	Satisfactory
Copper	Unsatisfactory
Monel	Unsatisfactory
Brass	Unsatisfactory

Seals and Gaskets	
Material	Recommendation
Derakane 411	Satisfactory
Derakane 470	Satisfactory
Heresite P4403	Unsatisfactory
PVC	Satisfactory
CPVC	Satisfactory
Teflon	Satisfactory
Kynar	Satisfactory
HDPE	Satisfactory
Polypropylene	Satisfactory

Flue Gas Desulfurization

Flexatrac-AGS-100's has an important use as an additive in the removal of sulfur dioxide from the furnace exhaust of coal burning power plants. The SO₂ is removed through a reaction with limestone; Flexatrac-AGS-100 acts to buffer and facilitate the dissolution of the limestone.

The reactions in a flue gas scrubber are very complex, and are discussed in detail in many published articles^{9,10}. In short, limestone, dissolved or suspended in water, reacts with SO₂ in the flue gas. This reaction removes the SO₂ from the stack gas, and forms either CaSO₃ or CaSO₄·2H₂O, commonly known as gypsum. Studies have shown 10-20% increase in dissolved limestone with organic acid use, and as a result, have shown a 10% increase in scrubber efficiency¹¹.

GHS Classification and Labeling

Under the Global Harmonized Standard for Hazard Communication (GHS), Version 4, Flexatrac-AGS-100 is classified as follows:

Category	Sub-Category	Classification
Physical Hazards		Not classified for any physical hazard
Acute Health Hazards	Serious Eye Irritation/ Eye Damage	Category 1, Causes Serious Eye Damage
Chronic Health Hazards		Not classified for any Chronic Health hazard
Specific Target Organ Toxicity (STOT), Acute Exposure	Respiratory Tract Irritation	Category 3, May Cause Respiratory Irritation
Acute Environmental Hazards	Toxicity to Algae	Category 3, Harmful to Aquatic Life
Long-term Environmental Hazards		Not classified for any long term environmental hazard
Signal Word		Danger

Pictogram	
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While the above information is consistent with GHS Version 4, individual implementations of GHS may differ in what classifications are appropriate.

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