



(First Applied Sorbent Treatment - Against Chemical Threats)

**CHEMICAL HAZARD CONTAINMENT AND
NEUTRALIZATION SYSTEM**

COMPETITIVE ANALYSIS

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INTRODUCTION

Chemical spills can be in a form of gas, liquid, solid, fumes, dust, fibers or vapors. For treatment of such spills various products are employed: acid and base neutralizers, all purpose absorbents, oil only absorbents, hazardous liquid absorbents, spill kits, decontaminating foams, spill containment and material handling products. Desired characteristics of a decontaminant are: neutralization of all agents, safety (non-toxic and non-corrosive), ease of application, rapid action, non-toxic end products, stability in long term storage, affordability and ease of disposal.

FAST-ACT

FAST-ACT (First Applied Sorbent Treatment – Against Chemical Threats) is a proprietary formulation of non-toxic nanomaterials effective for neutralizing a wide range of toxic chemicals with the added capability to destroy chemical warfare agents. FAST-ACT is offered in pressurized cylinders capable of addressing both liquid and vapor hazards as well as manually dispersed containers for liquid hazard treatment. Advantages of FAST-ACT are summarized below:

1. Effective against a wide range of toxic chemicals including
 - Acids
 - Halogenated Compounds
 - Phosphorus Compounds
 - Acidic and Caustic Gases
 - Organic Compounds
 - Chemical Warfare Agents

Effectiveness against a broad range of chemical hazards eliminates the need for multiple products. FAST-ACT has been tested for efficacy against a wide range of toxic chemicals and chemical warfare agents. In addition, NanoScale offers a Materials Testing Program to evaluate efficacy of FAST-ACT towards containment and/or neutralization of toxic chemicals which have not previously been verified.

2. Neutralizes both liquid and vapor hazards

The pressurized cylinders are designed to treat liquids and vapor hazards, making this technology truly unique and versatile, eliminating the need for ancillary equipment or multiple products.

3. Rapid acting upon contact
 - Life-safety threat reduction
 - Reduces on-site management time and cost

With FAST-ACT containment and/or neutralization efficacy greater than 95% is achieved for most toxic chemicals within 2 minutes. Within 90 seconds over 99.6% (detection limit) of warfare agent is removed from surfaces. In 10 minutes 99% of GD and over 99.9% of VX is destroyed. After 60 minutes 70-80% of HD is neutralized.

4. Non-toxic, non-corrosive, non-flammable

Extensive toxicity testing (oral, dermal irritation, dermal sensitization, eye irritation and inhalation) has been carried out on FAST-ACT and its components by USCHPPM (US Army Center for Health Promotion and Preventive Medicine), Aberdeen MD and MPI Research, Mattawan, MI and proven the formulation to be non-toxic. The formulation is non-corrosive, its pH does not exceed 12. In addition, FAST-ACT is non-flammable.

5. Dry powder formulation

Dry powder minimizes the logistical burdens and the damages associated with water based products.

6. Safe to apply to all liquid and vapor releases

FAST-ACT can be safely applied to any chemical hazard. This allows for the utilization of one product when responding to any known or unknown chemical situation.

7. Easy to operate delivery systems

- No premixing is required
- All units are portable

The formulation is ready for application, which greatly reduces the deployment time. FAST-ACT is offered in 5 different portable sizes (500g to 5 kg units).

8. No special training required

Operation of FAST-ACT units is very simple. The operation of pressurized cylinders is similar to fire extinguishers. Each unit is shipped with a user manual outlining instructions for use and application rates for select chemicals.

9. Effective over a wide range of temperatures and environmental conditions

Due to the dry powder nature of the product it is effective over a wide range of temperatures and environmental conditions. The reactions kinetics and adsorption/reaction equilibrium will vary depending on the temperature; however, the reaction mechanism will be the same.

10. Compact containers for easy storage

FAST-ACT units have been designed for easy storage in both vehicles and/or facilities. Accessories are available including wall and vehicle mounts to ensure the units are secure when not in use and still easily accessible when required.

OTHER NEUTRALIZATION/CONTAINMENT TECHNOLOGIES

1. Solid Commercial Neutralizers

Solid commercial neutralizers are used to treat only one type of the chemical hazard, (i.e., soda ash is used to neutralize acids); therefore, the pretreatment hazard identification is mandatory. Such technology can only treat liquid hazards. In addition, the amount of heat generated during neutralization can cause splattering of hot hazard. With excess of the neutralizers, a potentially corrosive situation is created.

2. Spill Kits

Separate products for acids, caustics and solvents; therefore, hazard identification is required before treatment. In some instances, if applied improperly a dangerous product may form (silica based solvent absorber on hydrofluoric acid will form silicon tetrafluoride, a hazardous colorless gas). Cannot treat vapor hazards. Not effective towards destruction of CWAs and organic hazards, such as insecticides.

3. Universal Neutralizer

Universal neutralizer can be applied to contain and liquid spill. However, it is not effective towards destruction of CWAs and many organic hazards, such as insecticides. Does not treat vapor releases.

4. Sorbent Based Decontamination Products

Designed primarily to treat chemical warfare agents. Not effective towards most toxic industrial chemicals. Do not treat vapor releases.

5. Liquid Decontamination Products

Liquid decontaminants are primarily used to treat chemical warfare agents. A majority of liquid decontamination products are corrosive (DS2, bleach). They cannot be used on metals such (i.e., potassium, sodium) and are not effective against a wide range of TICs. Since they are water based, they cannot be used at sub-zero temperatures. Liquid decontaminants do not treat vapor releases.

6. Foams

Decontaminating foams are designed to treat chemical and/or biological warfare agents. They have large logistical burdens due to water and ancillary equipment requirements as well as need for premixing. Since they are water based, they cannot be used below freezing temperatures.

The following sections provide more in-depth comparison between FAST-ACT and selected containment/neutralization technologies.

Table 1. Comparison of FAST-ACT® and Solid Commercial Neutralizers (i.e., Soda Ash, Caustic Soda, Sludge)

	FAST-ACT		Solid Commercial Neutralizers	
	<i>Containment</i>	<i>Neutralization</i>	<i>Containment</i>	<i>Neutralization</i>
Effectiveness				
<i>Acids or Caustic</i>	Yes	Yes	Yes ¹	Yes ¹
<i>Halogenated Compounds</i>	Yes	Partial	Yes	No
<i>Phosphorus Compounds</i>	Yes	Yes	Yes	No
<i>Acidic and Caustic Gases</i>	Yes	Yes	No	No
<i>Organic Compounds</i>	Yes	Partial	Partial ²	No
<i>Chemical Warfare Agents</i>	Yes	Yes	Yes	No
Liquid & Vapor Hazards	Yes		No	
Pretreatment Hazard Identification Requirement	No		Yes	
Safe for All Spills	Yes		No	
Packaging	Pressurized canisters, bulk pail, shaker bottle		Carton box, pail, drum	
Technical Support	Yes		No	
Material Testing Program	Yes		No	

¹ Majority of commercial acid neutralizers cannot be used to treat hydrofluoric acid

² Will not contain gases, i.e. ethylene oxide

Table 2. Comparison of FAST-ACT® and Spill Kits (i.e., Fisher, Spill-X, J.T. Baker)

	FAST-ACT		Spill Kits					
			Acid		Caustic		Solvent	
Effectiveness	Containment	Neutralization	Contain	Neutr	Contain	Neutr	Contain	Neutr
<i>Acids</i>	Yes	Yes	Yes ¹	Yes ¹	No	No	Yes ³	No
<i>Halogenated Compounds</i>	Yes	Partial	Yes	No	Yes	No	Yes	No
<i>Phosphorus Compounds</i>	Yes	Yes	Yes	No	Yes	No	Yes	No
<i>Acidic and Caustic Gases</i>	Yes	Yes	No	Partial	No	Partial	No	No
<i>Organic Compounds</i>	Yes	Partial	Partial ²	No	Partial ²	No	Partial ²	No
<i>Chemical Warfare Agents</i>	Yes	Yes	Yes	No	Yes	No	Yes	No
Liquid & Vapor Hazards	Yes		No		No		No	
Pretreatment Hazard Identification Requirement	No		Yes		Yes		Yes	
Safe for All Spills	Yes		No		No		No	
Packaging	Pressurized canisters, bulk pail, shaker bottle		Carton box, shaker bottle, pressurized canister ⁴		Carton box, shaker bottle, pressurized canister ⁴		Carton box, shaker bottle, pressurized canister ⁴	
Technical Support	Yes		?		?		?	
Material Testing Program	Yes		No		No		No	

¹ Majority of commercial acid neutralizers cannot be used to treat hydrofluoric acid

² Will not contain gases, i.e. ethylene oxide

³ Cannot be used with hydrofluoric acid, ex. Fisher silica based solvent absorber reacts with HF to produce silicon tetrafluoride, a hazardous colorless gas

⁴ Only Spill-X offers pressurized canisters (Spill-Gun)

Table 3. Comparison of FAST-ACT® and a Universal Neutralizer (Ampho-MAG)

Effectiveness	FAST-ACT		Ampho-MAG	
	<i>Containment</i>	<i>Neutralization</i>	<i>Containment</i>	<i>Neutralization</i>
<i>Acids</i>	Yes	Yes	Yes	Yes
<i>Halogenated Compounds</i>	Yes	Partial	Yes	Partial
<i>Phosphorus Compounds</i>	Yes	Yes	Yes	Partial
<i>Acidic and Caustic Gases</i>	Yes	Yes	No	Yes ¹
<i>Organic Compounds</i>	Yes	Partial	Partial ²	No
<i>Chemical Warfare Agents</i>	Yes	Yes	Yes	No
Liquid & Vapor Hazards	Yes		No	
Pretreatment Hazard Identification Requirement	No		No	
Safe for All Spills	Yes		Yes	
Packaging	Pressurized canisters, bulk pail, shaker bottle		Shaker bottle, 50 lb bags	
Technical Support	Yes		?	
Material Testing Program	Yes		No	

¹ The formulation will neutralize acidic and caustic gases; however, there are no means of dispensing the product

² Will not contain gases, i.e. ethylene oxide

Table 4. Comparison of FAST-ACT® and Sorbent Decontamination Products (i.e., Activated Carbon, Guild Alumina (SDS), M291, Fuller’s Earth)

	FAST-ACT		Sorbent Based Decontamination Products	
Effectiveness	<i>Containment</i>	<i>Neutralization</i>	<i>Containment</i>	<i>Neutralization</i>
<i>Acids or Caustic</i>	Yes	Yes	Yes	No
<i>Halogenated Compounds</i>	Yes	Partial	Yes	No
<i>Phosphorus Compounds</i>	Yes	Yes	Yes	Partial
<i>Acidic and Caustic Gases</i>	Yes	Yes	No	No
<i>Organic Compounds</i>	Yes	Partial	Partial ¹	No
<i>Chemical Warfare Agents</i>	Yes	Yes	Yes	Yes
Liquid & Vapor Hazards	Yes		No	
Pretreatment Hazard Identification Requirement	No		No	
Safe for All Spills	Yes		Yes	
Packaging	Pressurized canisters, bulk pail, shaker bottle		Pouches, pads, shaker bottle, glove	
Technical Support	Yes		?	
Material Testing Program	Yes		No	

¹ Will not contain gases, i.e. ethylene oxide

Table 5. Comparison of FAST-ACT® and Liquid Decontamination Products (i.e., Bleach, DS2, Hydrogen peroxide)

	FAST-ACT		Liquid Decontamination Products	
	<i>Containment</i>	<i>Neutralization</i>	<i>Containment</i>	<i>Neutralization</i>
Effectiveness				
<i>Acids or Caustic</i>	Yes	Yes	No	No
<i>Halogenated Compounds</i>	Yes	Partial	No	No
<i>Phosphorus Compounds</i>	Yes	Yes	No	Yes
<i>Acidic and Caustic Gases</i>	Yes	Yes	No	No
<i>Organic Compounds</i>	Yes	Partial	No	Partial
<i>Chemical Warfare Agents</i>	Yes	Yes	No	Yes
Liquid & Vapor Hazards	Yes		No	
Pretreatment Hazard Identification Requirement	No		Yes	
Safe for All Spills	Yes		No	
Packaging	Pressurized canisters, bulk pail, shaker bottle		Drums	
Ancillary Equipment	No		Sprayer	
Deployment Time	Immediate		5-10 minutes	
Operational Conditions	All		Above freezing	
Technical Support	Yes		No	
Material Testing Program	Yes		No	

Comments:

Most of liquid decontamination products are corrosive.

Liquid decontamination products cannot be used on alkaline (i.e., sodium) and alkaline earth (i.e., magnesium) metals.

Table 6. Comparison of FAST-ACT® and Foams (i.e., Sandia Foam, CASCAD)

Effectiveness	FAST-ACT		Foams	
	<i>Containment</i>	<i>Neutralization</i>	<i>Containment</i>	<i>Neutralization</i>
<i>Acids or Caustic</i>	Yes	Yes	No	No
<i>Halogenated Compounds</i>	Yes	Partial	Yes	No
<i>Phosphorus Compounds</i>	Yes	Yes	Yes	Yes
<i>Acidic and Caustic Gases</i>	Yes	Yes	No	No
<i>Organic Compounds</i>	Yes	Partial	Yes	Partial
<i>Chemical Warfare Agents</i>	Yes	Yes	Yes	Yes
Liquid & Vapor Hazards	Yes		No	
Pretreatment Hazard Identification Requirement	No		Yes	
Safe for All Spills	Yes		No	
Active Shelf-life	Years		8 hours	
Packaging	Pressurized canisters, bulk pail, shaker bottle		Spray bottles, drums	
Ancillary Equipment	No		Sprayer, fogger, foam generator	
Deployment Time	Immediate		30 minutes	
Operational Conditions	All		Above freezing	
Operator Skill/Training	Low		High	
Technical Support	Yes		?	
Material Testing Program	Yes		No	

Liquid decontamination products cannot be used on alkaline (i.e., sodium) and alkaline earth (i.e., magnesium) metals.