

PRODUCT DESCRIPTION

The Fluid Tech, Inc. (FTI) products are solidification/stabilization agents, developed for the efficient and economical disposal of radioactive, hazardous chemical, and mixed wastes. They are:

AQUASET®
AQUASET II®
AQUASET II-H

PETROSET®
PETROSET-H
PETROSET II®

They are slightly alkaline, non-flammable, non-reactive and non-corrosive, and are not biodegradable. These reagents immobilize wastes (liquid, sludge, or solid) through the action of complex bonding mechanisms and ion exchange reactions. The end result is a homogenous waste solid with excellent leach resistance.

They have significant advantages over other S/S technologies:

- A - **Volumetric Efficiency.** Typical volume expansions with FTI products run between 5% and 20%. Corresponding expansions with cement and/or pozzolanic treatments run between 50% and 125%. This has the effect of greatly affecting the most expensive cost element in the whole process - namely, final disposal. For example, between 45 and 48 gallons of waste can be solidified by FTI products, with room to spare, in a 55-gallon drum.
- B - **Leaching Resistance.** The ability of a treated waste to withstand groundwater attack (assumed to be acid) is measured for radioactive wastes by Test ANS/ANSI 16.1; for chemically hazardous wastes by the EPA TCLP (40 CFR Part 261, Appendix II); and, for mixed wastes, by both.

The attached Performance Data sheets illustrate results achieved by FTI products in solidifying and chemically stabilizing a wide variety of pollutants and matrices.

- C - **Retention of VOC's** (Volatile Organic Compounds). Cementitious and/or pozzolanic treatment reactions are strongly exothermic. Temperature rises of 24EC have been observed during treatment mixing. Under these conditions VOC's (if present) tend to be "cooked-out" into the atmosphere. If not confined, collected, and treated, they can be a source of regulatory embarrassment.

FTI products, on the other hand, produce temperature rises on the order of 2EC to 4EC, thus substantially reducing this "cook-out" phenomenon.

MIXED WASTE PRODUCT APPLICATIONS

Aquaset

Aquaset is a water-activated, granular solidification agent used for treatment of aqueous liquids containing small amounts of dissolved and suspended solids, detergents, chelating agents, resins, and up to 5% oils. Aquaset does not require stirring, and is utilized by simple addition to the aqueous liquid waste. Usually only 100 to 150 pounds of Aquaset are required to solidify 45 to 48 gallons of liquid waste in a 55-gallon drum.

Aquaset II, Aquaset II-H

Aquaset II is a powdered solidification agent used either alone or in combination with Petroset or Petroset II. Aquaset II finds its greatest utility in the solidification of aqueous solutions extremely high in dissolved solids, such as neutralized acids and bases, and those organic liquids that are water soluble or miscible. Examples of organic liquids in this category would include alcohols, benzenes, glycols, and low molecular weight ketones. Mixtures of Aquaset II and Petroset II are ideal when the above liquids are present in combination with oils and/or greases. Use of Aquaset II requires power-mixing equipment.

Petroset, Petroset-H

Petroset is chemically similar to granular Aquaset, but instead is a finely divided powder. Its application requires power mixing, either with an impeller (drum mixing) or a ribbon-blender or pugmill (continuous or bulk mixing). It thus can be used to treat wastes with high solids content, including heavy sludges. With the addition of water, dry solid wastes can be successfully treated to meet TCLP leach-resistance standards. Power mixing is required.

Petroset II

Petroset II is a finely ground, strongly organophilic solidification/stabilization agent. It is used in the treatment of wastes, some or all of whose liquid components are not water-miscible (such as oils). Treatment of wastes which have both water-miscible and water immiscible components is accomplished through the use of a combination of Petroset II with Petroset, or Petroset II with Aquaset II.

Petroset II, used alone, will not solidify nor chemically stabilize aqueous phases of a waste. With the addition of Aquaset II or Petroset, as described above, heavy metal contaminants in the aqueous phase of a two-phase waste will be chemically stabilized simultaneously with the organic components. Power mixing is required.

Curing

With two exceptions (Petroset-H and Aquaset II-H) FTI solidifiers cure to a stiff putty-like consistency in from one to twenty-four hours, depending upon the nature of the raw waste and its matrix.

Petroset-H and Aquaset II-H are chemically equivalent to their respective namesakes. They differ in that they cure more slowly (48 to 96 hours), and result in a hard end product. Again, depending on the makeup of the raw waste, typical 28-day Penetrometer readings will be well over 3.6 tons per square foot (50 PSI).

Mixing

With the exception of Aquaset, which is a granular product designed for use on aqueous wastes with negligible solids, all of the FTI products are finely divided powders (200 mesh). Good dispersion of the solidifier material within the waste matrix is essential to ensure that there are no "islands" of untreated waste. Since these materials begin to "catch" or clot the waste rather quickly, good shear action is desirable to break down over-treated clots, and to achieve good dispersion.

In drums, a simple four-blade impeller, slightly smaller in OD than the ID of the drum, works well. Means should be provided to raise and lower the impeller during mixing. Bulk mixing can be done in a ribbon blender, pug mill, or similar apparatus.

SUMMARY

These brief product descriptions are presented as general guidelines in the use of Fluid Tech solidification media. Because of nearly endless waste varieties, determination of a specific waste and Fluid Tech media recipe is essential to achieve optimum balance of efficiency and economy. The following table provides an overview of typical waste and Fluid Tech solidifier combinations. The amount of FTI solidifiers required for a given waste will vary with the type and concentration of organics present and/or the ionic concentration and character of the aqueous phase, as well as the solids content.

TYPICAL LIQUID WASTE/FTI SOLIDIFIER COMBINATIONS

(per 55 Gallon Drum)

WASTE TYPE	WASTE VOLUME	FLUID TECH PRODUCT	FLUID TECH PRODUCT TREATMENT WEIGHT
Aqueous, low ionic concentration	45-48 gallons	Aquaset or Petroset	100-150 lbs.
Aqueous, high ionic concentration	43-47 gallons	Aquaset II	125-175 lbs.
Glycols, Ketones, water miscible organics	42-46 gallons	Aquaset II	125-200 lbs.
Pure oils, Solvents, Chlorinated Hydrocarbons	40-47 gallons	Petroset II	80-130 lbs.
Acids and Bases, Neutralized, pH 5-10	42-47 gallons	Petroset and Aquaset II	125-175 lbs. total treatment
Waste Lubricating oil and water	41-48 gallons	Petroset and Petroset II	100-150 lbs. total treatment
Waste Lubricating oil and glycols	40-44 gallons	Aquaset II and Petroset II	90-160 lbs. total treatment

Direct comparisons between (a) Fluid Tech solidification/stabilization systems, and (b) other systems are difficult to make. Variations in waste types, and within individual waste streams, as well as in liquid loading levels, leachant dissimilarities, and lack of specific isotope release rate information all make direct comparisons difficult to find.

Using available information, FTI solidified wastes generally demonstrate leach rates 2 orders of magnitude lower than another generally known system (Envirostone Cement).

In the table following, each whole number (Leachability Index) represents 1 order of magnitude in release of pollutant. Higher values of LI represent lower pollutant release during leaching. Average Leachability Indices are calculated from diffusion coefficients. There were 11 leach periods, covering a total of one year.

FLUID TECH Product	LEACHANT	Sr-85	LEACHABILITY Cs-137	INDEX Co-60	Ave.
Aquaset	#1 Dist. water	8.8	9.3	9.6	9.2
	#2 pH 2.3	7.3	10.0	8.8	8.7
	#3 pH 5.7	8.7	10.3	9.9	9.6
	#4 pH 9.5	8.9	9.7	10.0	9.5
	#5 Seawater	6.9	9.5	9.8	8.7
Aquaset II	#1 Dist. water	8.1	6.4	9.0	7.8
	#2 pH 2.3	8.1	6.6	9.3	8.0
	#3 pH 5.7	8.5	6.7	9.0	8.1
	#4 pH 9.5	8.6	6.4	9.8	8.3
	#5 Seawater	7.9	6.7	9.5	8.0
Petroset	#1 Dist. water	9.1	9.4	9.5	9.3
	#2 pH 2.3	7.3	9.0	8.4	8.2
	#3 pH 5.7	8.7	9.7	9.5	9.3
	#4 pH 9.5	8.3	10.5	9.4	9.4
	#5 Seawater	6.6	10.1	10.1	8.9
Petroset II	#1 Dist. water	8.6	9.4	9.6	9.2
	#2 pH 2.3	9.1	9.5	9.9	9.5
	#3 pH 5.7	8.6	10.0	10.1	9.6
	#4 pH 9.5	8.7	9.9	9.7	9.4
	#5 Seawater	9.6	10.3	10.1	10.0
	Average:	8.3	8.9	9.5	8.9

PERFORMANCE REPORT B LEACHABILITY - U.S. EPA TCLP EXTRACTION AND ANALYSIS

CAKES/SLUDGES

Electroplating wastes (F006), usually presented as a wet filter cake or a stiff sludge, are easily treated by Petroset-H or Aquaset II-H to levels of leachability far below those required by the U.S. EPA for land disposal. Eleven examples, showing the results of the treatment of plating wastes from widely differing operations, illustrate the ability of these stabilizers to tie-up heavy metals. The results achieved, and the regulatory requirements (maxima) are expressed in mg/l:

Waste No.	Cd	Cr	Pb	Ni	Ag
1	0.005	0.054	<0.05	0.04	<0.01
2	0.008	0.320	0.003	0.018	0.002
3	<0.005	0.533	<0.05	0.15	<0.01
4	<0.005	1.90	<0.05	<0.04	<0.01
5	<0.005	0.601	<0.05	<0.04	<0.01
6	<0.027	1.54	<0.05	<0.04	<0.01
7	<0.014	0.395	0.002	0.030	<0.01
8	0.024	0.037	0.058	0.098	0.001
9	0.013	0.044	0.025	0.111	0.001
10	0.029	1.641	0.049	0.110	0.002
11	0.023	1.562	0.043	0.112	0.001
EPA Limit	0.066	5.200	0.510	0.320	0.072

PERFORMANCE REPORT C LEACHABILITY - U.S. EPA TCLP EXTRACTION AND ANALYSIS

SOIL

A soil contaminated with both toxic organic compounds and heavy metals was treated with a combination of Petroset II and Petroset, simultaneously mixed. The results:

	Ethyl Benzene	Naphthalene	Chromium	
Raw Soil 2(untreated)	84	151	23	mg/kg
Test Result	0.67	0.13	<0.5	mg/l

A comparison test using Portland cement succeeded in capturing the chromium, but failed completely on the organics.

The rise in temperature, using Petroset II and Petroset, was 2.3 Celsius degrees. The corresponding rise with Portland cement was 26.7 Celsius degrees.

PERFORMANCE REPORT D LEACHABILITY - U.S. TCLP EXTRACTION AND ANALYSIS

SOLIDS

Ash from the baghouse of a large commercial incinerator (a "Characteristic" waste) was treated with 15% Aquaset II (by weight), with the following results (mg/l):

Metal	TCLP Raw Ash	TCLP Treated Ash	40 CFR 261.24 Limit	Waste Codes
As	28.5	<0.20	5.00	D004
Ba	1,382.0	0.33	100.00	D005
Cd	27.5	0.02	1.00	D006
Cr	452.5	<0.01	5.00	D007
Pb	1,875.5	<0.10	5.00	D008
Se	*	<0.30	1.00	D010
Ag	*	<0.05	5.00	D011

* No Data Available

PERFORMANCE REPORT E

PCB LEACHABILITY

Oil/PCB, Treated by Petroset II

Raw Waste:	Arochlor 1260	3.5%
	Oil	90.0%
	Alcohol	6.5%

		100.0%

Results: (Method 8080) mg/kg

Raw Waste	35,000.	Arochlor 1260
Treated Waste	0.4	Arochlor 1260

PERFORMANCE REPORT F LEACHABILITY - U.S. EPA TCLP EXTRACTION AND ANALYSIS

LIQUIDS

A clear liquid waste bearing seven of the eight EPA "Characteristic" heavy metals was solidified with Petroset-H, with the following results (mg/l):

As	Ba	Cd	Cr	Pb	Se	Ag	
0.100	0.928	0.010	0.554	0.018	0.197	0.112	TCLP Result
5.0	100.0	1.00	5.00	5.00	5.70	5.00	EPA Max. Limits

PERFORMANCE REPORT G

FREEZE/THAW
All Samples: 4 complete cycles

Cycle: - 14°C Freeze 24 hrs.
 + 22°C Thaw 24 hrs.

LIQUID	TREATMENT		RESULT
	Petroset	(#/Gal) Aquaset II	
5% Ethylene Glycol	2	1	Dry, no breaks
15% Ethylene Glycol	2	1	Dry, no breaks
25% Ethylene Glycol	2	1	Dry, no breaks
40% Ethylene Glycol	2	1	Dry, no breaks
50% Ethylene Glycol	1	3	Dry, no breaks
65% Ethylene Glycol	1	4	Dry, no breaks
90% Ethylene Glycol	1	5	Dry, no breaks
1% Na ₂ S	4	0	Dry, no breaks
45% Na ₂ S	0	4	Dry, no breaks
Satur. NaCl	0	5	Dry, no breaks

PERFORMANCE REPORT H

LEACHABILITY - TCLP

Oil/Water, Metals Contamination

Waste:	Waste Lube Oil	84.5%
	Alcohol	5.4%
	Water	8.5%
	Toxic Metals	1.3%

		100.0%

Metal	Raw Waste mg/kg	TCLP (treated) mg/l	EPA Req'd (maximum) mg/l
Lead	1813	<0.5	5.0
Barium	1522	10	100
Arsenic	2195	<0.5	5.0
Chromium	1884	<0.5	5.0
Mercury	1697	0.07	0.20
Selenium	580	<0.1	1.0
Silver	1841	<0.5	5.0

Additionally, oil and grease were determined on the SW-846 EPA extract by standard Freon extraction and was found to be 0.3 mg/l (ppm).

SOLIDIFICATION OF EVAPORATOR CONCENTRATES AND RESIN WASTES

APPLICATION

Simulated waste formulations representing common power plant wastes were solidified using the Fluid Tech media shown below. For each waste, the required weight of specific Fluid Tech products combined with the noted volume of waste, indicate 55-gallon drum quantities that will exhibit the characteristic of a freestanding monolith.

SPECIFIC WASTE EXAMPLES

1. **Bead Resin Waste**

<u>Material</u>	<u>Weight Percent</u>
Water	50
Bead Resin (a)	50
Temp.	70 F
pH	7.0

Solidification: Use 75 lbs. Petroset to 47 gal. waste

2. **BWR Precoat Filter Cake (with powdered resin)**

<u>Material</u>	<u>Weight Percent</u>
Water	50
Anion Powdered Resin (b)	20
Cation Powdered Resin (b)	20
Crud (c)	5
Sodium Chloride	5
Temp.	70 F
pH	7.0

Solidification: Use 25 lbs. Aquaset II first; then 50 lbs. Petroset to 47 gal. waste

3. **BWR Precoat Filter Cake (with diatomaceous earth)**

<u>Material</u>	<u>Weight Percent</u>
Water	50
Diatomaceous earth	40
Crud (c)	10
Temp.	70 F
pH	7.0

Solidification: Use 75 lbs. Petroset to 47 gal. waste

4. **BWR Chemical Regenerative Waste/ Forced Recirc. Evaporator**

<u>Material</u>	<u>Weight Percent</u>
Water	75
Sodium sulfate	23
Sodium chloride	2
Temp.	170 F
pH	6.0

Solidification: Use 100 lbs. Aquaset II first; then 75 lbs. Petroset in 45 gal. waste

5. **PWR Chemical Regenerative Waste/ Forced Recirc. Evaporator**

<u>Material</u>	<u>Weight Percent</u>
Water	72.9
Sodium sulfate	15
Ammonium sulfate	10
Sodium chloride	2
Crud (c)	0.1
Temp.	170 F
pH	3.5

Solidification: Use 100 lbs. Aquaset II first; then 75 lbs. Petroset to 45 gal. waste

6. **Decontamination Waste/ Forced Recirc. Evaporator**

<u>Material</u>	<u>Weight Percent</u>
Water	80
EDTA	14.4
Citric acid	5
Crud (c)	0.2
Lube oil	0.4
Temp.	170 F
pH	5.0

Solidification: Use 165 lbs. Aquaset II first; then 45 lbs. Petroset to 42 gal. waste

7. **Boric Acid Waste/
Forced Recirc. Evaporator**

<u>Material</u>	<u>Weight Percent</u>
Water	87.9
Boric acid	12.0
Crud (c)	0.1
Temp.	170 F
pH	3.5

Solidification: Use 160 lbs. Petroset to 45 gal. waste

8. **BWR Chemical Regenerative Waste/
Thin Film Evaporator**

<u>Material</u>	<u>Weight Percent</u>
Water	50
Sodium sulfate	45.8
Sodium chloride	4.0
Crud (c)	0.2
Temp.	170 F
pH	6.0

Solidification: Use 150 lbs. Aquaset II first; then 50 lbs. Petroset to 43 gal. waste

9. **PWR Chemical Regenerative Waste/
Thin Film Evaporator**

<u>Material</u>	<u>Weight Percent</u>
Water	50
Sodium sulfate	29
Ammonium sulfate	16.8
Sodium chloride	4.0
Crud (c)	0.2
Temp.	170 F
pH	3.3

Solidification: Use 150 lbs. Aquaset II first; then 50 lbs. Petroset to 43 gal. waste

10. **Boric Acid Waste/
Thin Film Evaporator**

<u>Material</u>	<u>Weight Percent</u>
Water	50
Boric acid	49.8
Crud (c)	0.2
Temp.	170 F
pH	3.0

Solidification: Use 135 lbs. Petroset to 45 gal. waste

11. **Decontamination Waste/
Thin Film Evaporator**

<u>Material</u>	<u>Weight Percent</u>
Water	50
EDTA	29.8
Citric acid	19
Crud (c)	0.2
Lube oil	1.0
Temp.	170 F
pH	5.0

Solidification: Use 150 lbs. Aquaset II first; then 50 lbs. Petroset to 43 gal. waste

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- (a) - Waste Dowex Resin
 - (b) - Waste Dowex Resin (ground)
 - (c) - Floor Sweepings