DECONGEL®
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TITLE: Surface Decontamination of Tin compounds (tributyltin chloride) by DeconGel™ 1101

ABSTRACT

Surface decontamination efficacy of DeconGel™ 1101 on stainless steel, aluminum, and concrete surfaces contaminated with tin compound (tributyltin chloride); experimentation and associated analyses was performed with ICP-OES (Inductively Coupled Plasma-Optical Emission Spectroscopy) according to Environmental Protection Agency (EPA) SW-846 Methods: 3005A (sampling) and 6010C (analysis).

HAZARDOUS MATERIALS RELEVANCE

Tin compounds (organotin) have been extensively used as biocides, wood preservatives, and as anti-biofouling agents, however, concerns over potent toxicity to marine life have led to a worldwide ban by the International Maritime Organization. Organotin compounds are considered environmentally persistent pollutants.

SUMMARY RESULTS

- As seen in Table 1, excellent surface decontamination was achieved by applying DeconGel 1101 via brushing onto contaminated surfaces, resulting in encapsulation of organotin contaminant by DeconGel's active components. Decontamination efficacies of brushed DeconGel 1101 ranged from 99.0% (on concrete) to 99.3% (on aluminum) to 99.4% (on stainless steel) as determined by residual swipe analysis; decontamination efficacies of poured DeconGel 1101 ranged from 86.9% (on concrete) to 96.2% (on stainless steel) to 96.3% (on aluminum) as determined by residual swipe analysis.
- Optimized experimental and analytical methods were successfully developed following standardized EPA sampling and analysis methods as guidelines for determination of inorganics/organometallics in aqueous/polar aprotic solvated samples. When necessary, the digestion methods were customized to result in the complete dissolution of the inorganic contaminants and to ensure accurate decontamination efficacy determination of DeconGel.

RESULTS

Table 1 shows the decontamination efficacies of DeconGel 1101 on stainless steel, aluminum, and concrete surfaces contaminated with organotin compound (tributyltin chloride) as determined by residual swipe testing.

Table 1. Decontamination efficacies of DeconGel 1101 on Organotin (tributyltin chloride) on stainless steel, aluminum, and concrete surfaces as determined by residual swipe testing.

Swipe Testing (ppm)		Formulation
		DeconGel 1101
Stainless Steel	Control	465.03 ± 2.80
	Residual (non-brushed)	17.84 ± 0.88
	Residual (brushed)	2.82 ± 0.60
	Decon. Efficacy (non-brushed) (%)	**96.2 ± 0.21**
	Decon. Efficacy (brushed) (%)	**99.4 ± 0.10**
Aluminum	Control	468.37 ± 3.39
	Residual (non-brushed)	17.24 ± 0.83
	Residual (brushed)	3.34 ± 0.28
	Decon. Efficacy (non-brushed) (%)	**96.3 ± 0.21**
	Decon. Efficacy (brushed) (%)	**99.3 ± 0.10**
Concrete	Control	341.73 ± 3.79
	Residual (non-brushed)	44.82 ± 0.77
	Residual (brushed)	3.47 ± 0.45
	Decon. Efficacy (non-brushed) (%)	**86.9 ± 0.16**
	Decon. Efficacy (brushed) (%)	**99.0 ± 0.12**

764x dilution factor for samples and controls

NOTES

- Application of a homogenous, thin layer of the organotin liquid contaminant on the respective substrate facilitated an optimized interaction between contaminant and DeconGel, and an accurate measure of DeconGel's decontamination efficacy in a scaled-down yet real-world setting. No less than 6.0 g of DeconGel was used for each experiment to allow an optimized interaction between contaminant and DeconGel.
- ASTM method E1728-03, a standardized swipe testing method used for sampling of contaminants, was the integral method used to accurately evaluate DeconGel's decontamination efficacy. Air-dried GhostWipe™ (Environmental Express; Mt. Pleasant, SC) swipes wetted with DMSO solvent were utilized in this swipe testing method.
- Standardized EPA SW-846 Sampling Method 3005A "Acid Digestion of Waters for Total Recoverable or Dissolved Metals for Analysis by FLAA or ICP Spectroscopy" was followed as a guideline to prepare all samples and controls. All samples, controls, and standards were prepared using the same dissolution solution and experimental conditions to ensure both correct instrument calibration and accurate analytical results.
- ICP-OES instrumentation is a sensitive and accurate analytical tool for qualitative and quantitative determination of a large number of inorganic compounds. Standardized EPA SW-846 Analytical Method 6010C "Inductively Coupled Plasma-Atomic Emission Spectrometry" was followed as a guideline to prepare all samples and controls.

- To ensure accurate determination of DeconGel decontamination efficacy, calibration standards of the analyte of interest were prepared using either a sufficiently pure analyte or an appropriate ICP-MS Standard (Ricca Chemical Company; Arlington, TX); the respective standards were diluted to a known concentration (ppm) using the same digestion method as the one used for samples and controls. Instrument blank controls were DI H_2O ($\geq$17 M-Ohm) and DMSO solvent.

CALCULATIONS

Decontamination Efficacy (Swipe Testing) =
[(Contaminant (ppm) of Swipe Control) – (Contaminant (ppm) of Residual Swipe)/Contaminant (ppm) of Swipe Control] x 100%

MATERIALS AND METHODS

Sample Method

In a typical procedure, 0.080 g tributyltin chloride contaminant was evenly applied via brushing on 1) aluminum (surface area: 56.3 cm^2), 2) stainless steel (surface area: 56.3 cm^2), or 3) concrete (industrial grade, surface area: 56.3 cm^2) coupons. Approximately 6.0 g of DeconGel 1101 was either poured or brushed (brushed first in a top-bottom, then in a left-right fashion) onto the contaminated surface and let to dry for 24 hours. Dried DeconGel samples were peeled off the contaminated surface, and the surface was swipe tested (ASTM method E1728-03) using an air-dried GhostWipe™ swipe (Environmental Express; Mt. Pleasant, SC) wetted with DMSO solvent (2 mL). Swipe and dried film samples were suspended in 50 mL DMSO for 24 hours. Samples were then analyzed using ICP-OES following EPA SW-846 Method 6010C (analysis).

Control Methods

For swipe control samples, a respective amount of contaminant was evenly applied via brushing on 1) aluminum (surface area: 56.3 cm^2), 2) stainless steel (surface area: 56.3 cm^2), or 3) concrete (industrial grade, surface area: 56.3 cm^2) coupons, and the surface was swipe tested (ASTM method 1728-03) using an air-dried GhostWipe™ swipe (Environmental Express; Mt. Pleasant, SC) wetted with DMSO solvent (2 mL). Swipe samples were suspended in 50 mL DMSO for 24 hours. Samples were then analyzed using ICP-OES following EPA SW-846 Method 6010C (analysis).

Reagents and Standards

Tributyltin chloride, liquid, (CAS# 1461-22-9, Fisher Scientific; Fair Lawn, NJ), was used as received.

A 1000 ppm calibration standard of contaminant was prepared using tributyltin chloride in DMSO solvent. DMSO was used as the blank sample.

Analytical Instrumentation

A Thermo ICP-OES instrument model radial iCap 6300 was used to determine tin concentration (ppm) of all samples and controls using a freshly prepared 1000 ppm calibration standard.

Analyte (aluminum) analyzed at 189.9 nm

Pump Speed: 0.5 mL/min

APPLICATION INSTRUCTIONS FOR END-USERS

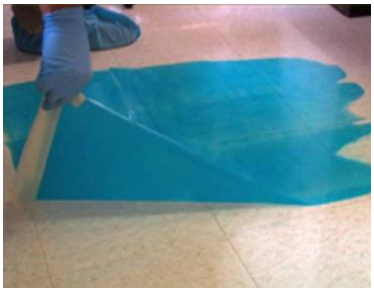
Use product directly as is from container. DO NOT DILUTE. Masking or painters tape can be applied along one edge of the area that is to be decontaminated to aid creating a peeled edge to grip for peeling the dried film. Apply DeconGel using a paint brush, a trowel, a handheld sprayer, or an industrial grade sprayer (use DeconGel 1120 or 1121 for spray application).

The thickness of the gel and the number of coats is dictated by the surface to be decontaminated. Coating thickness required for good peel characteristics varies with substrate and generally increases with substrate porosity. It is recommended that first time customers test DeconGel on a small sample area to confirm the required film thickness and dry time for their specific application. If the film is difficult to peel, please apply an additional coat. A razor blade is useful to start the peel. Lay the blade nearly flat and fillet the edge of the film to create a tab that can be pulled. For surfaces that the gel adheres to well, such as concrete, 12" – 24" strips can be cut in the film resulting in less force being required to peel the film.

- Let DeconGel dry for 24 hours

Dry time will vary depending on humidity, temperature, air flow and thickness of the DeconGel. This can take from as little time as an hour for thin coats in a dry environment with plenty of airflow, to overnight or longer if thicker coats are applied in humid environments. Dry times exceeding 24 hours may sometimes be required for good peel performance on bare concrete, wood and other highly porous substrates and substrates with deep cracks or grooves. However, 18-24 hours is often sufficient dry time on good quality concrete. It is recommended that users test a small area to determine drying time prior to applying DeconGel for an entire job. Supplemental heat or air circulation will accelerate DeconGel's drying time for any job.

- Peel DeconGel off the surface by starting from one of the edges



When dry, the product locks the contaminants into a polymer matrix. The film containing the encapsulated contamination can then be peeled. DeconGel peels from most non-porous and porous hard surfaces if the dried film is thick enough. If the film is difficult to peel, add another coat, let dry, and peel. In most cases the DeconGel will come off in a single sheet but for odd shaped surfaces you may be required to score DeconGel in order to peel it off.

- Dispose of the dried DeconGel in accordance with the local, state and Federal disposal regulations of the contaminant/substance you are removing. DeconGel itself has no special disposal restrictions.

For questions about DeconGel or to place an order, visit our website at www.decongel.com or contact us at:
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