DECONGEL®
A PRODUCT OF CBI POLYMERS

TITLE: Surface Decontamination of Beryllium Compounds Utilizing Beryllium Surrogates (Elemental Aluminum Powder (Al) and Aluminum Oxide (Al_2O_3)) by DeconGel™ 1101.

SUBSTRATE

Surface decontamination efficacy determination of DeconGel™ 1101 on stainless steel, carbon steel, and concrete surfaces contaminated with beryllium surrogate compounds (aluminum powder (Al) and aluminum oxide (Al_2O_3)) was performed by 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

Beryllium compounds are used in the aerospace industry to construct lightweight and resilient alloys. Beryllium is directly corrosive to living tissue; beryllium dust is toxic by inhalation and can cause berylliosis, an incurable chronic lung disease. Due to beryllium toxicity, the commonly used beryllium surrogate aluminum was used in this study. Aluminum powder and aluminum oxide were chosen as representative beryllium surrogate compounds for evaluating DeconGel's efficacy; DeconGel is expected to have similar efficacy towards the wide range of beryllium surrogate compounds.

SUMMARY RESULTS

- Excellent surface decontamination was achieved by applying DeconGel 1101 onto surfaces contaminated with aluminum metal dust and aluminum oxide (surrogates for beryllium metal dust and beryllium oxide respectively) resulting in encapsulation of contaminants by DeconGel's active components. Decontamination efficacies of DeconGel 1101 ranged from 99.6% and 99.7% (on concrete) to 99.5% and 99.9% (on carbon steel) to 97.9% and 99.7% (on stainless steel) for aluminum metal dust and aluminum oxide respectively as determined by residual swipe analysis.
- Optimized experimental and analytical methods were successfully developed following standardized EPA sampling and analysis methods as guid[e]lines for determination of inorganic compounds in aqueous samples. When necessary, experimental methods were customized to afford complete dissolution of inorganic contaminants, and to ensure accurate decontamination efficacy determination of DeconGel.

RESULTS: Tables 1 and 2 show the decontamination efficacies of DeconGel 1101 on stainless steel, carbon steel, and concrete surfaces contaminated with aluminum powder (Al) and aluminum oxide (Al_2O_3) as determined by residual swipe testing.

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

Swipe Testing (ppm)		**Formulation** DeconGel 1101
Stainless Steel	Control	1113.0 ± 17.0
	Residual	23.3 ± 5.3
	Decon. Efficacy (%)	**97.9 ± 2.0**
Carbon Steel	Control	944.7 ± 0.2
	Residual	4.7 ± 4.3
	Decon. Efficacy (%)	**99.5 ± 4.6**
Concrete	Control	511.7 ± 12.7
	Residual	1.8 ± 0.2
	Decon. Efficacy (%)	**99.6 ± 3.8**

2280x dilution factor for samples and controls

Table 2. Decontamination efficacies of DeconGel against aluminum oxide (Al_2O_3) on stainless steel, carbon steel, and concrete surfaces as determined by residual swipe testing method.

Swipe Testing (ppm)		**Formulation** DeconGel 1101
Stainless Steel	Control	420.8 ± 7.0
	Residual	1.4 ± 0.6
	Decon. Efficacy (%)	**99.7 ± 7.7**
Carbon Steel	Control	505.5 ± 22.4
	Residual	0.3 ± 0.3
	Decon. Efficacy (%)	**99.9 ± 4.4**
Concrete	Control	420.2 ± 6.1
	Residual	1.3 ± 0.7
	Decon. Efficacy (%)	**99.7 ± 5.9**

2280x dilution factor for samples and controls

NOTES:

- ASTM method E1728-03, a standardized swipe testing method used for the sampling of inorganic contaminants, was the integral method used to accurately evaluate DeconGel's decontamination efficacy. GhostWipe™ (Environmental Express; Mt. Pleasant, SC) swipes (pre-wetted with DI H_2O) 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. When deemed necessary, digestion methods were customized by increasing hydrochloric and nitric acid concentrations from 25% to 35% wt, and/or by heating samples to higher temperatures using a HotBlock™ Sample Heater (Environmental Express; Mt. Pleasant, SC) to facilitate the complete

digestion/dissolution of the inorganic contaminants. 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).
- Beryllium surrogates (aluminium metal powder (Al) and aluminium oxide (Al_2O_3) for beryllium metal powder (Be) and beryllium oxide (BeO) respectively) have been utilized in this evaluation studies due to the high toxicity and carcinogenicity of beryllium metal and beryllium compounds.

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, 0.05 g of contaminant was evenly applied on 1) stainless steel (commercial grade, surface area: 56.3 cm^2), 2) carbon steel (commercial grade, surface area: 100 cm^2), or 3) concrete (industrial grade, surface area: 56.3 cm^2) coupons. Approximately 6.0 g of DeconGel 1101 was poured onto the contaminated surface and let to dry for 24-48 h. Dried DeconGel samples were peeled off the contaminated surface, and the surface was swipe tested (ASTM method E1728-03) using a GhostWipe™ swipe (Environmental Express; Mt. Pleasant, SC). Swipe samples were suspended in 100 mL aqueous acidic solution (20% HCl, 15% HNO_3, 65% deionized (DI) H_2O) for 24 h and were then analyzed via ICP-OES (see below).

Control Methods

For swipe control samples, the respective amount of contaminant was evenly applied on 1) stainless steel (commercial grade, surface area: 56.3 cm^2), 2) carbon steel (commercial grade, surface area: 100 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 a GhostWipe™ swipe (Environmental Express; Mt. Pleasant, SC). Swipe samples were suspended in 100 mL aqueous acidic solution (20% HCl, 15% HNO_3, 65% DI H_2O) for 24 h and analyzed via ICP-OES (see below).

Reagents and Standards
Aluminium metal, Al, finest powder grade, (CAS# 7429-90-5, Fisher Scientific; Fair Lawn, NJ), was used as received. Aluminium oxide, Al_2O_3, 60-325 Mesh, (CAS# 1344-28-1, Fisher Scientific; Fair Lawn, NJ), was used as received.

A 1000 ppm calibration standard of each contaminant was prepared using the beryllium surrogates and freshly prepared aqueous acidic solution (20% HCl, 15% HNO_3, 65% DI H_2O). DI H_2O ($\geq$ 17 M-Ohm) was used as the blank sample.

Analytical Instrumentation.
A Thermo ICP-OES instrument model radial iCap 6300 was used to determine aluminum concentration (ppm) of all samples and controls using a freshly prepared 1000 ppm calibration standard.
Analyte (aluminum) analyzed at 308.2 nm; Pump Speed: 0.5 mL/min.

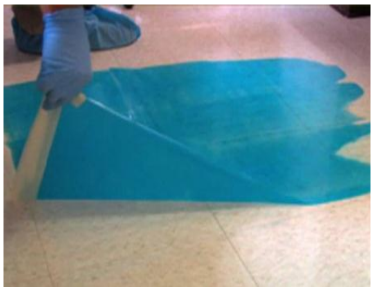
APPLICATION INSTRUCTIONS FOR END-USERS
Use product directly as is from container. DO NOT DILUTE. Masking or painters tape can be applied along one edge of the area that is to be decontaminated to aid creating a peeled edge to grip for peeling the dried film. Apply DeconGel using a paint brush, a trowel, 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:
CBI Polymers Inc.
1946 Young Street, Suite 480
Honolulu, Hawaii 96826
(808) 949-2215 ext. 146
orders@decongel.com