FINAL

Supplement to the February 2014 Final Remedy Work Plan
Area 1 Work Plan
Whirlpool Corporation
Fort Smith, Arkansas

Prepared for:
Whirlpool Corporation

Prepared by:
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1 INTRODUCTION

ENVIRON International Corporation (ENVIRON), on behalf of Whirlpool Corporation, is submitting this Supplement to the February 2014 Final Remedy Work Plan for Area 1 (Work Plan) for the Whirlpool Fort Smith facility located at 6400 Jenny Lind Road on the south side of Fort Smith, Arkansas (the "Site"). This Work Plan is being submitted in accordance with the Remedial Action Decision Document (RADD) issued by Arkansas Department of Environmental Quality (ADEQ) on December 27, 2013.

The proposed Area 1 remedy and supplemental remedial actions for the adjacent linear trench feature (see Area 1 Soil Investigation Summary Report, submitted August 15, 2014, for discussion of the linear trench feature) represents the next step in the adaptive remedy approach being employed to facilitate implementation of the most effective remedial actions to address current onsite and offsite conditions. The proposed actions enhance the scope of the remedy in Area 1 based upon the latest data collected since the RADD was finalized (see Area 1 Soil Investigation Summary Report for a summary of the latest data) and will supplement the ongoing remediation activities that began earlier this year, including two in-situ chemical oxidation (ISCO) injection events performed in Areas 1, 2 and 3 and the neck area (remediation at the neck area is supplemental to the RADD) in March and late May/early June 2014.

The proposed Area 1 remedy and supplemental remedial actions for the linear trench feature, which are discussed in more detail below, include a supplemental soil removal effort in the linear drainage feature including backfilling with limestone gravel to adjust the naturally low groundwater pH to enhance natural attenuation followed by an ISCO injection event in the area of the linear drainage feature and Area 1. The work to be performed within the linear drainage feature is being conducted as an interim corrective action measure (interim measure) [executed Consent Administrative Order, paragraph 10 (LIS 13-202)] and is supplemental to the work required in the RADD. The soil removal effort will be implemented via the use of large diameter borings which will result in the removal of approximately 300 cubic yards (yd^3) of trichloroethylene (TCE) impacted soil. This impacted soil will be properly characterized and permitted for disposal off site. Soil removal provides certainty regarding the effective removal of TCE impact in soil in Area 1 and the linear drainage feature. The limestone gravel backfill in the large diameter borings is proposed to increase the naturally low groundwater pH to a neutral pH condition to enhance natural attenuation. TCE impact in saturated soil and groundwater will be addressed via ISCO technology. The supplemental interim measure and knowledge regarding the effective radius for ISCO injections has facilitated a technical basis for the reduction in the number of injection points for ISCO in Area 1 (see Section 3.2). Subsequent remedy performance monitoring and groundwater monitoring required by the RADD will be sufficient to assess the effectiveness of the remedy performed for Area 1.

Based upon the new site characterization data collected from Area 1 and the linear drainage feature and the information/data gathered during the first two ISCO injection events, the combined soil removal effort, groundwater pH adjustment and ISCO via permanent and temporary injection points is an appropriate and effective approach to remediate soil and groundwater impact in Area 1 and the linear drainage feature. Following the Adaptive Remedy

Approach being employed for remediation activities at the site, the effectiveness of this enhanced remedy in Area 1 will continue to be assessed, and supplemental remedial action will be performed if the data suggests further efforts are necessary to reduce TCE concentrations (i.e. additional removal actions, supplemental ISCO injection events at existing injection points, or performance of additional ISCO injection at other locations).

The proposed Area 1 remedy and supplemental remedial actions for the linear trench feature will be implemented over a period of approximately eight to eleven weeks following approval by ADEQ, receipt of all necessary permits, and mobilization of contractors.

This Work Plan describes the enhanced remedy for Area 1 consisting of remedial efforts to address impacted soil and groundwater associated with a linear drainage feature identified during investigations performed after the RADD was finalized, as well as remedial efforts to address impacted soil and groundwater in Area 1. This Work Plan document includes:

- Summary of the data obtained from Area 1;
- Discussion of the supplemental interim measure consisting of soil remedy proposed for the linear drainage feature and installation of permanent injection wells near the linear drainage feature as well as within Area 1;
- Discussion of the third ISCO injection event (permanent and temporary injection points); and
- Discussion of monitoring, schedule and health and safety.

2 SUMMARY OF AREA 1 DATA

2.1 GENERAL SITE DESCRIPTION

The Whirlpool facility is approximately 153 acres and includes the former main manufacturing building [approximately 1.3 million square feet (ft^2)], separate warehouse and administrative offices, and approximately 21 acres of undeveloped land. Historical manufacturing processes at the Whirlpool Fort Smith facility involved metal fabrication, plastic thermoforming and assembly operations. Dating back to approximately 1967, equipment degreasing operations utilizing TCE were performed in the former degreaser building located near the northwestern corner of the main manufacturing building and west of the boiler house. The degreaser building is depicted on Figure 1, and is located near the northeast corner and north boundary of Area 1.

2.2 AREA 1 AND LINEAR DRAINAGE FEATURE CHARACTERIZATION

Area 1 consists of a 325 foot by 80 foot area (26,000 ft^2) at the northwest corner of the former Whirlpool manufacturing building. Area 1 is designated as a specific area for remediation in the ADEQ RADD.

The data used in developing the scope is provided in the Area 1 Soil Investigation Summary Report and summarized below.

As part of the adaptive remedy approach, membrane interface probes (MIP) were advanced using direct push technology (DPT) during sequential investigations beginning in September 2013 and continuing through January 2014 to assess potential soil impacts in Area 1 and other portions of the site (MIP is a continuous, semi-quantitative screening-type investigative technology). Subsequently, soil probes were performed to investigate soil and groundwater at select locations where the MIP investigation suggested TCE impacts may be present.

The data from the MIPs and subsequent soil probes were received in late January 2014. A review of logs from the MIP borings in and around Area 1 indicate that the highest electron capture device (ECD) response indicating a relatively higher concentration of volatile organic compounds (VOCs) within Vadose Zone soils was found in six borings (M-244, M229, M-226, M-78, M-227 and M-219 see Figure 1) located along the former linear drainage feature that began near the former degreaser building and ran to the west southwest toward the former rail spur on the north side of the building. Relatively high ECD responses were also noted in Vadose Zone soils at M-225 and M-242 located immediately west and east of the former degreaser building, respectively. ECD responses were lower in Vadose Zone soils at borings located further to the north and south of the former linear drainage feature while responses in saturated soil in the Basal Transmissive Zone were higher to the south of the former linear drainage feature. ECD responses were low in both the Vadose Zone and Basal Transmissive Zone soils in borings located near the western end of Area 1 and the former linear drainage feature.

Similar to the MIP ECD results, the TCE concentrations in Vadose Zone soils are highest near the centerline of the former linear drainage feature [each of the borings along the centerline have at least two samples with TCE concentrations greater than 10 milligrams per kilograms (mg/kg)] and decrease to the north and south. TCE concentrations in both the Vadose Zone soils and saturated soil in the Basal Transmissive Zone were lower in borings located near the western end of the former linear drainage feature and west of Area 1. TCE concentrations generally decrease with depth in the borings along the centerline of the former linear drainage feature, except at MW-86 and DP-08 where TCE concentrations are higher in saturated soil in the Basal Transmissive Zone. The TCE concentrations in saturated soil samples measured at MW-86 was 137 mg/kg at a depth of 26.25 feet and at DP-08 was 3,300 mg/kg at a depth of 18.75 feet. These two saturated soil samples exhibit the highest TCE soil concentrations measured at the Site. TCE concentrations in soil exhibit slightly increasing trends with depth in borings to the north and south of the former linear drainage feature.

Based upon this data and the adaptive remedy approach, the first ISCO injection event was performed in Area 1 during the week of March 28, 2014. Monitoring was performed to assess the effectiveness of the first ISCO event. Prior to the 2014 second ISCO injection event, six monitoring wells were installed in and around the target injection areas. Two of these wells (MW-85 and MW-86), are located near MW-25 in the northeast corner of Area 1 (see Figure 1) (MW-86 is in the linear drainage feature). During installation, soil samples were collected from the borings for these two wells and submitted for laboratory analysis. The second ISCO injection event was performed during the weeks of May 27 and June 4, 2014.

Groundwater monitoring results for the west side of Area 1 have exhibited TCE concentrations ranging from 14.5 milligrams per liter (mg/L) to 43 mg/L in MW-25 and 8.3 mg/L to 16 mg/L in ITMW-19 since October 2013. MW-86 installed in the linear drainage feature on the west side of Area 1 (located approximately 30 feet east of MW-25) was sampled prior to the second ISCO injection event in May 2014 and exhibited a TCE concentration of 533 mg/L. Monitoring results from the east side of Area 1 have exhibited TCE concentrations ranging from 0.2 mg/L to 3.0 mg/L in ITMW-11 and 2.5 mg/L to 8.6 mg/L in ITMW-18 since October 2013. In comparison, the TCE concentrations in groundwater on the west side of Area 1 exhibit concentrations approximately an order of magnitude greater than TCE concentrations on the east side of Area 1.

To summarize:

- TCE concentrations in soils decrease to the north and south from the centerline of the former linear drainage feature;
- The highest TCE concentrations are generally located near the center of the former linear drainage feature extending roughly from DP-29 to the east towards DP-08 to the west;
- TCE concentrations in soils generally decrease with depth in the Vadose Zone soils generally being higher than in the saturated Basal Transmissive Zone soils;
- The highest TCE soil concentration (3,300 mg/kg) was characterized at DP-08; and

- TCE concentrations in groundwater are highest on the western portion of Area 1 at MW-86 and are approximately an order of magnitude greater than TCE concentrations in groundwater on the eastern portion of Area 1.

The characterization data confirms the source of TCE impact northwest of the former Whirlpool manufacturing building is associated with impacts along the linear drainage feature and Area 1.

2.3 AREA 1 AND LINEAR DRAINAGE FEATURE SUBSURFACE DESCRIPTION

The Vadose Zone soil consists of variable soil types ranging from silty clay and silt generally in the upper 4 feet below ground surface (bgs) and consists of silty to sandy clay generally from 4 feet bgs to the surface of Basal Transmissive Zone encountered from 15 to 17 feet bgs in Area 1, and is 16 feet (ITMW-18) to 25.5 feet (MW-25) feet thick in Area 1. The Basal Transmissive Zone can be subdivided into two primary units; the upper unit composed primarily of silty sand to sandy silt and the lower unit composed primarily of sands and gravels. This upper “sand” unit is generally only present on site and ranges from 2 to 9 feet thick. The lower unit of the Basal Transmissive Zone consists primarily of sand and gravel that is generally 4 to 7 feet thick on site with variable amounts of clay and silt and is not present (ITMW-18) to 5 feet thick (ITMW-19) feet thick in Area 1. This sand and gravel layer rests on silty clay with sand and gravel followed by weathered shale and clayey silt that transition to underlying shale. The thickness of the silty clay layer appears to decreases from north to south and is not present near the western boundary of Area 1. Top of shale bedrock was encountered at depths ranging from 27 to 30 feet. Underlying the Basal Transmissive Zone is the McAlester formation which acts as a lower confining layer precluding further vertical migration of impacted groundwater. The McAlester shale consists of dark gray shales and siltstones with thin beds of coal and is approximately 500 feet thick in the Ft. Smith area (Geology of the Fort Smith District Arkansas, Geological Survey Professional Paper 221-E, T.A. Hendricks and Bryan Parks, 1949, p. 74).

Based upon previous groundwater level measurements performed during groundwater monitoring events, a groundwater hydraulic divide exists north of the northwest corner of the building, and this hydraulic divide is typically located to the north of Area 1. The location of the hydraulic divide varies slightly in a north and south direction during groundwater monitoring events, and the hydraulic divide is not perfectly linear nor is the hydraulic divide perfectly oriented in an east-west direction. Little or no groundwater gradient has been measured in the vicinity of Area 1 (i.e. little or no groundwater gradient north or south of the hydraulic divide).

Based upon review of recent groundwater monitoring data, the majority of the affected groundwater has migrated south from the hydraulic divide that is coincidentally typically located slightly north of the linear drainage feature (see discussion in Section 2.2).

3 AREA 1 AND LINEAR DRAINAGE FEATURE – SUPPLEMENTAL INTERIM MEASURE SOIL REMEDY AND INSTALLATION OF PERMANENT INJECTION POINTS

Based upon the new site characterization data collected after the RADD was finalized and the information/data gathered during the first two ISCO injection events, the combined soil removal effort, groundwater pH adjustment and ISCO via permanent and temporary injection points is an appropriate and effective approach to remediate soil and groundwater impact in Area 1 and the linear drainage feature. In accordance with the adaptive remedy approach, the remedy for Area 1 and the supplemental interim measure for the linear drainage feature will be implemented and monitored closely to ensure the intended remediation goals are achieved. The details for implementation of the supplemental interim measure for the linear drainage feature and the remedy for Area 1 are presented in the sections below. Details for the third ISCO event are described in Section 4.

3.1 SUPPLEMENTAL INTERIM MEASURE - SOIL REMOVAL IN THE LINEAR DRAINAGE FEATURE

The supplemental interim measure soil removal consists of an effective removal of both impacted Vadose Zone soil and the underlying impacted saturated soil in the Basal Transmissive Zone along the linear drainage feature leading from the former degreaser building within and near Area 1. Soil removal provides certainty regarding the effective removal of TCE impact in soil in Area 1 and the linear drainage feature. A series of 4 foot diameter borings will be completed along the linear drainage feature using an approximate 15 foot spacing between borings (see Figure 1, specific locations subject to field location adjustments due to underground utilities). These 4 foot diameter borings will be completed to the top of the underlying shale with depths anticipated to range from 26 feet up to possibly 32 feet bgs. Each boring will result in the removal of approximately 14 yd^3 of impacted soil; therefore, the total amount excavated after performance of 19 borings will account for the removal of approximately 265 yd^3 (345 bulk yd^3 assuming a 30% bulking factor after excavation). Temporary casing may be utilized while performing the borings, if necessary, to keep the respective borings open prior to backfilling as described below. If temporary casing is used, this casing will be retrieved from the respective borings while backfilling is performed.

Drill cuttings/spoil will be stockpiled for subsequent disposal characterization. Two segregated stockpiles will be used to manage the drill cuttings/spoil consisting of:

- Stockpile 1 containing spoils from the eight large diameter borings in the linear drainage feature north of Area 1 excluding the spoils from the boring at DP-07; and
- Stockpile 2 containing the spoils from the ten remaining larger diameter borings in Area 1 plus the spoils from the large diameter boring at DP-07 (one of the ten large diameter borings is located west of Area 1 and the spoils from the boring will be included in the subject stockpile).

In general, the TCE concentrations in soil are greater based upon the soil samples collected from DP-07, DP-08 and locations in the vicinities of MW-25 and MW-86. Spoils in Stockpile 2 are anticipated to exhibit higher concentrations of TCE; and are therefore, segregated for disposal characterization purposes.

Stockpiles 1 and 2 will be contained on and covered with plastic sheeting while disposal characterization is performed. Disposal permitting will be based upon characterization sampling from the respective stockpiles (i.e. disposal as a special industrial waste or as a characteristically hazardous waste). Disposal characterization sampling will include performance of toxicity characteristic leachate procedure (TCLP) testing to assess whether the drilling cuttings/spoil may exhibit characteristics requiring disposal as a hazardous waste, as well as other parameters requested from disposal facilities to facilitate proper disposal.

Proposed disposal facilities consist of Clean Harbors' Lone Mountain, LLC RCRA disposal facility in Waynoka, Oklahoma for characteristically hazardous spoils, and Waste Management's Tontitown Landfill in Springdale, Arkansas, or the Fort Smith Landfill for non-hazardous excavation spoils. Other permitted disposal facilities may be utilized based upon the results of disposal characterization and permitting efforts.

The large diameter borings will be backfilled with crushed limestone gravel to approximately 15 feet bgs and the remaining annular space will be filled with lean cement (i.e. sand with Portland cement) to within approximately 1 to 2 feet from the surface. The final 1 to 2 feet of surface completion will match the surrounding area (i.e. concrete or asphalt pavement, gravel or soil; whichever is present at the surface prior to performing the boring).

The objective of increasing the naturally low groundwater pH is to enhance natural attenuation. Crushed limestone gravel was selected to backfill the borings as part of the supplemental interim measure to potentially increase the background groundwater pH which ranges from 4.5 to 6.7. Low pH may inhibit natural attenuation since most microbes that biodegrade TCE (i.e. monitored natural attenuation) prefer a neutral range for pH from 6 to 8.

3.2 AREA 1 INJECTION POINTS

Permanent injection points will be constructed on an approximate 25 foot grid spacing throughout the remainder of Area 1 and the linear drainage feature (supplemental interim measure). The approximate 25 foot grid spacing was selected based upon data gathered during the tracer study and the first two ISCO injection events in accordance with the adaptive remedy approach (i.e. the effective radius for injection is typically greater than 10 feet but seldom greater than 15 feet due to the heterogeneity of the subsurface). Approximately 40 permanent injection points will be installed based upon the approximate 25 foot grid spacing. Because lower TCE concentrations are encountered on the eastern portion of Area 1 and the monitoring of the first injection event in this area showed that persulfate concentrations persist in the injection area for more than 60 days, approximately 21 temporary injection points are proposed in this area for the third ISCO injection event. The total number of injection points may be enhanced by one or two locations in the field based upon the number of injections wells in Injection Array 3 and the overlapping injection wells in the linear drainage feature. The 61 injection points proposed for the third ISCO event (40 permanent and 21 temporary injection points) plus the five permanent and ten temporary injection points from first and second ISCO events creates a total of 76 injection points in Area 1 and the linear drainage feature. The number of injection points in Area 1 and the linear drainage feature has been reduced from the total specified in the RADD based upon the effective radius for oxidant injection observed during the first two ISCO injection events in Area 1.

The permanent injection wells and subsequent temporary injection points in Area 1 and the linear drainage feature will be completed in the Basal Transmissive Zone. The permanent injection points will be completed with 2 inch diameter PVC, 5 foot long well screens and 2 inch diameter PVC well casing to the surface. A 20/40 grade sand pack will be installed in the well annulus around the PVC screen to approximately 2 feet above the top of the screen followed by a minimum of 2 feet of annular seal consisting of hydrated bentonite chips above the top of the sand pack. The remainder of the annular space will be filled with a bentonite/cement grout. The wells will be completed at the surface with a traffic rated flush mount protective cover installed within a concrete apron.

The completion of the borings for the permanent injection points in Area 1 will result in the removal of slightly less than 1 yd^3 of impacted soil per boring; therefore, the total amount excavated after performance of 40 borings will account for the removal of approximately 25 yd^3 of soil (30 bulk yd^3 assuming a 30% bulking factor after excavation). Drill cuttings/spoil will be properly managed and contained to facilitate disposal characterization following completion of the borings as described in Section 3.1. Drill cuttings from borings within Area 1 and within 30 feet of the linear drainage feature will be added to Stockpile 2, and all other drill cuttings will be added to Stockpile 1.

3.3 ESTIMATE QUANTITY OF SOIL REMOVED

The estimated quantity of soil to be removed for the supplemental interim measure for Area 1 totals approximately 300 yd^3 (400 bulk yd^3 assuming a 30% bulking factor after excavation) based upon the estimated volumes removed during performance of the large diameter borings and installation of permanent injection points within the linear drainage feature and in Area 1.

3.4 SUMMARY

The supplemental interim measure and Area 1 remedy consisting of soil removal with groundwater pH adjustment coupled with ISCO injections in the linear drainage feature and Area 1 will reduce TCE concentrations in Area 1 in accordance with the adaptive remedy approach. Soil removal provides certainty regarding the effective removal of TCE impact in soil in Area 1 and the linear drainage feature. The permanent and temporary injection points will be utilized to perform the third ISCO injection event (see Section 4 for further discussion). Subsequent monitoring required by the RADD will be used to assess the effectiveness of the remedy performed for Area 1 (see Section 5.2 for discussion of new monitoring wells). As demonstrated by Whirlpool during implementation of the Adaptive Remedy Approach for the site, the effectiveness of the supplemental interim measure and Area 1 remedy will be assessed, and supplemental remedial action will be performed if the data suggests further efforts are necessary to reduce TCE concentrations (i.e. additional removal actions, supplemental ISCO injection events at existing injection points, or performance of additional ISCO injection at other locations).

4 THIRD ISCO EVENT

The third ISCO event will be performed in Area 1 and the linear drainage feature via permanent and temporary injection points to remediate TCE impacts characterized in saturated soil and groundwater in the vicinity.

Either base activated sodium persulfate (BASP) or Modified Fenton's reagent (hydrogen peroxide and chelated iron) activated sodium persulfate (MASP) will be used for the third ISCO event in injection wells in Area 1 and the linear drainage feature (supplemental interim measure). MASP was assessed during the bench scale testing for this project and has demonstrated an increased ability to treat adsorbed phase TCE. The MASP reagents will be introduced into the shallow water bearing zone via the 2 inch diameter injection wells to be installed as described in Section 4.2. MASP was used during the second ISCO injection event in Area 1. In accordance with the adaptive remedy approach, if the MASP oxidant does not demonstrate optimal, efficient oxidation of TCE in the vicinity of MW-25 based upon performance monitoring to be performed during the week of September 14, 2014, the BASP oxidant which was used during the March 2014 ISCO event in Area 1 will be considered.

A supplemental description of the third ISCO event will be provided to ADEQ in support of the underground injection authorization granted by the ADEQ. ADEQ determined that the described injection activities for the first and second 2014 ISCO injection events were "authorized by rule" as described in 40 CFR 144.84.

4.1 REAGENT PREPARATION

The MASP will be injected at an approximate concentration of 18%. The hydrogen peroxide will be shipped and stored in Department of Transportation (DOT) approved drums. The reagents will be mixed together in a staging area constructed adjacent to the injection site. Modifications to reagent may occur based upon the results of the second ISCO injection event, based upon the adaptive remedy approach utilized for the site. Material safety data sheets (MSDSs) for the reagents are provided in Appendix A.

The BASP oxidant, if used, will be injected at an approximate concentration of 12%. Sodium persulfate will be shipped to the site as a dry powder in 55 pound bags and sodium hydroxide in DOT approved 55 gallon high density polyethylene (HDPE) drums at an initial concentration of 25%. The two reagents will be mixed together in a staging area constructed adjacent to the injection site. MSDSs for the reagents are provided in Appendix A.

Water used during the injection event will be obtained from an active water line within the Whirlpool boiler building. A box truck will be utilized as a mobile chemical staging/preparation area housing miscellaneous equipment such as hoses, pumps, drums, tanks, mixers, generator and compressor. All liquid chemicals stored within the box truck will be staged within secondary containment units. As a precautionary safety measure, a fire extinguisher and emergency eye-wash station will be staged close to the chemical preparation area.

4.2 REAGENT INJECTION

The oxidant solution will be delivered into the subsurface via the existing injection wells at pressures ranging from 0 to 30 pounds per square inch (psi) and flow rates of 0.5 to 4 gallons per minute (gpm). During injection, the instantaneous flow rate and pressure at the respective wellheads will be monitored and recorded at routine intervals. The planned number of injection locations and quantities per area are as follows:

- Injection Wells: Inject 200 gallons each into 40 new injection wells for a total of 7,200 gallons of oxidant solution; and
- Temporary Injection Points: Inject 50 to 200 gallons each into 21 temporary injection points, for a total of approximately 1,050 to 4,200 gallons of MASP solution.

The above oxidant injection volumes are subject to change based upon the monitoring results from the second ISCO injection event. Equal quantities of oxidant will not be injected at each location in Area 1. The volume of oxidant will be modified for the respective injection points based upon the sampling performed during the baseline monitoring described in Section 5.1 (i.e. higher volumes of oxidant will be injected in areas exhibiting greater groundwater impact). We have learned from previous injection events that a volumetric limitation that may require injection of smaller volumes in select wells and repeating the injection several times at these wells due to back pressure that develops in the wells. This condition will be monitored during the injection and the injection plan modified accordingly.

5 MONITORING

Consistent with the adaptive remedy approach, groundwater monitoring will be implemented before, during and after the remedy in Area 1 and the linear drainage feature described above to monitor remediation progress to ensure that remediation goals are achieved and determine whether additional remediation activities are necessary.

5.1 BASELINE

The depth to water will be measured in various wells in Area 1 and the linear drainage feature prior to injection to enable the construction of an area potentiometric surface map. Low flow sampling methodology will be used to monitor and collect temperature, conductivity, dissolved oxygen (DO), pH and oxidation-reduction potential (ORP) readings. Following stabilization, groundwater samples will be collected from the designated wells and submitted to Pace Analytical Services, Inc. VOC analysis by EPA Method 8260.

The baseline sampling will include approximately ten of the permanent injection points and five newly installed monitoring wells (see Section 5.2) (see Figure 1 for monitoring well locations). The presence of free-product will be assessed in these new injection points and monitoring wells as requested in ADEQ correspondence dated April 25, 2014.

5.2 ADDITIONAL MONITORING WELLS

Five additional monitoring wells will be installed in the locations indicated on Figure 1. These new wells will provide monitoring capabilities in strategic locations within and just down-gradient from the injection areas where current wells do not provide sufficient coverage to evaluate the oxidation process.

The drilling and installation of the new monitoring wells will be completed using hollow stem auger or sonic drilling techniques. Each boring will be continuously sampled and the soil samples logged and field screened with a photoionization detector (PID) by an ENVIRON geologist. The new wells at each injection area will be installed to the surface of shale bedrock. Each well will be constructed with a 2 inch diameter PVC, 10 foot long well screen and 2 inch diameter PVC well casing to the surface. A 20/40 grade sand pack will be installed in the well annulus around the PVC screen to approximately 2 feet above the top of the screen followed by 2 feet of annular seal consisting of hydrated bentonite chips above the top of the sand pack. The remainder of the annular space will be pressure grouted with a bentonite/cement grout installed with a tremie pipe from the bottom of the open well annulus to the surface. The wells will be completed at the surface with a traffic rated flush mount protective cover installed within a concrete apron. Drill cuttings/spoil will be properly managed and contained in Stockpile 1 to facilitate disposal characterization following completion of the borings as described in Section 3.1.

During installation of these new monitoring wells, soil samples will be collected using EPA Method 5035 and submitted for VOC analysis per EPA Method 8260. The soil samples will be collected in the Vadose Zone, the upper portion of the saturated zone (sandy clays, clayey sands, and sandy silts) and in the coarser grained more permeable zone (clayey sand and sub-rounded gravel) targeting potentially impacted soil as indicated by field screening at a rate of one sample per every 5 foot depth interval.

5.3 INJECTION MONITORING

As indicated above, flow rate, volume and injection pressure at the well head will be monitored and recorded during MASP and BASP solution injection.

Monitoring of designated wells located within the injection areas and adjacent to the injection areas during injection will be completed periodically. The data collection will include water levels, temperature, conductivity, DO, pH, ORP and sodium persulfate using CHEMetrics' persulfate field test kit that employs the ferric thiocyanate method. Sodium persulfate tests will be performed only after elevated pH or conductivity readings are observed that indicate the presence of injection solution in the samples. Grab groundwater samples for field water quality parameters and sodium persulfate concentrations will be collected using disposable bailers or peristaltic pumps.

5.4 POST INJECTION MONITORING

The post injection monitoring for field parameters and sodium persulfate concentrations will be conducted at select wells within the first week following injection to provide an indication of the distribution of oxidant within the subsurface. These grab groundwater samples for field water quality parameters and sodium persulfate concentrations will be collected using disposable bailers or peristaltic pumps. Post injection monitoring for field parameters, field sodium persulfate concentrations, and laboratory analytical VOC concentrations will occur at approximately 30 and 90 days post injection. Monitoring will include depth to water at wells in the immediate area during one event to enable the construction of an area potentiometric surface map. Low flow sampling methodology will be used to monitor and collect temperature, conductivity, DO, pH and ORP readings. Sodium persulfate using CHEMetrics' persulfate field test kit will also be analyzed in select wells. Following stabilization, groundwater samples will be collected from the designated wells and submitted to Pace Analytical Services, Inc. for VOC analysis by EPA Method 8260. The post injection sampling schedule may be enhanced based on field monitoring results, scheduling additional injection events, and scheduling of quarterly groundwater monitoring events.

The post injection monitoring results will be summarized in subsequent quarterly reports as the data becomes available.

6 SCHEDULE

The work proposed for Area 1 will be performed in two stages, the installation of large diameter auger borings and permanent injection points followed by performance of the third ISCO injection event. The drilling phase is anticipated to be completed within three to six weeks after mobilization (dependent upon the number of drill rigs utilized and drilling subcontractor availability). Well development is anticipated to commence after drilling operations are nearly complete and will require two weeks to complete. Baseline sampling will commence after well development is complete and will require one week to complete.

The third ISCO injection event will occur after the baseline sampling event for Area 1 is complete. The third ISCO injection event is anticipated to require two weeks to complete.

The total schedule to implement the work in Area 1 is anticipated to require a total of eight to 11 weeks to complete following approval by ADEQ, receipt of all necessary permits and mobilization of contractors.

7 HEALTH AND SAFETY

The installation of large diameter auger borings presents safety hazards typical at heavy construction sites. These hazards include underground utilities; overhead hazards; heavy equipment hazards; slip, trip and fall; etc. Prior to initiation of site activities, the selected drilling contractor's specific safety plan and the ENVIRON Health and Safety Plan will be reviewed by ENVIRON safety professionals.

Two previous oxidant injection events have been completed and health and safety concerns for the third injection event will be managed similarly to the two previous events. ISOTEC (ISCO injection contractor) has a successful history of managing risks associated with ISCO injection events. Prior to any site activities specific to the oxidant injection, ISOTEC and ENVIRON health and safety plans will be reviewed by ENVIRON health and safety professionals.

Tailgate safety meetings will be conducted daily. The day's activities will be discussed in detail including the appropriate level of PPE for the task, and appropriate exclusion zone distances for the activities taking place.

FINAL

FIGURES

AERIAL PHOTOGRAPH OBTAINED FROM GOOGLE EARTH PRO. PHOTO TAKEN MAY 6, 2014.

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LEGEND

- – – EXTENT OF AREA 1
- ▬ FORMER LINEAR DRAINAGE FEATURE
- ⊕ MIP BORINGS
- ⊕ ERM BORINGS
- ⊕ DP BORINGS
- ⊕ MPSB BORINGS
- ● MONITORING/INJECTION WELLS
- ● INJECTION POINTS (INSTALLED AS WELLS)
- ✚ PROPOSED MONITORING WELL
- ◉ TEMPORARY INJECTION POINTS
- ⊗ LARGE DIAMETER BORINGS @15'O.C.

APPROX. SCALE (ft.)
0 30

AREA 1 DETAIL
WHIRLPOOL FACILITY
FORT SMITH, ARKANSAS

ENVIRON

FIGURE
1

DRAFTED BY: CKL/ELS
DATE: 8/11/14
3433233A

L:\Loop Project Files\00_CAD FILES\34\NMRS_Whirlpool Ft. Smith LitSup 3433233A\02_Area 1 Detail (r081114).dwg

APPENDIX A

Reagent Material Safety Data Sheets

MATERIAL SAFETY DATA SHEETS

Please note that all Material Safety Data Sheets provided for ISOTEC^{SM} reagents are for pure components in dry form. Prior to in-situ injection, ISOTEC^{SM} catalyst reagent is prepared by diluting these dry components in excess of water, typically by a factor of 50-100 (by weight). Therefore, the properties and effects described in the Material Safety Data Sheets are significantly lower for each component. For hydrogen peroxide, 35% to 50% concentration is typically diluted in water by a factor of 2-7 (by weight).

MSDS # 6368
Brenntag Northeast

kemira

MATERIAL SAFETY DATA SHEET

HYDROGEN PEROXIDE (20 to 60%)

KEM001 **Revised March 2010**

CHEMICAL PRODUCT/COMPANY IDENTIFICATION

Material Identification

Formula : H_2O_2
Molecular Weight : 34.02

Trade Names and Synonyms

Standard grade hydrogen peroxide aqueous solutions: 30SG, 35SG, 50SG
Kemi-Pure™ food grade hydrogen peroxide aqueous solutions: 30FG, 35FG, 50FG

Product Use	Bleaching Agent Oxidizing Agent
Standard Grade:	- certified by NSF to meet NSF/ANSI Standard 60 requirement for drinking water treatment - most suitable grade for industrial bleaching; water, effluent and soil treatments; and general oxidation reactions - Kosher-certified (COR 721)
Kemi-Pure™	- meets Food Chemical Codex requirements food-related applications - NSF and Kosher-certified

Company Identification

MANUFACTURER/DISTRIBUTOR

Kemira Chemicals Canada Inc.
1380 County Road 2
P.O. Box 615
Maitland, Ontario K0E 1P0

PHONE NUMBERS

Product Information:	1-800-263-5902
Transportation Emergency Response:	1-800-567-7455 (24 HOURS)
Product/Medical Emergency:	1-800-303-4338 (24 HOURS)

NOTICE FROM KEMIRA: The information on this material Safety Data Sheet relates only to the specific material designated herein and does not relate to use in combination with any other material or in any process.

COMPOSITION/INFORMATION ON INGREDIENTS

COMPONENTS

Material	CAS Number	%
Hydrogen Peroxide	7722-84-1	20-60
Water	7732-18-5	80-40

HAZARDS IDENTIFICATION

Potential Health Effects

Hydrogen peroxide may cause severe irritation or burns of the skin, eyes and mucous membranes. Splashes in the eye can cause severe eye damage with ulceration of the cornea and may cause irreversible eye damage, including blindness. Skin exposure can result in bleaching of the skin and hair.

Inhalation of concentrated vapors can cause irritation of the nose and throat with chest discomfort, cough, difficulty in breathing and shortness of breath.

Ingestion can cause irritation of the upper gastrointestinal tract with pain and distention of the stomach and esophagus due to liberation oxygen.

Gross overexposure by ingestion may be fatal.

Human Health Effects:

Skin contact with aqueous solutions of less than 50% may cause irritation with discomfort or rash. Higher or prolonged exposure may result in skin burns or ulceration. Evidence suggests that skin permeation can occur in amounts capable of producing systemic toxicity. Effects of eye contact with aqueous solutions of less than 5% may include eye irritation with discomfort, tearing, or blurring of vision. Higher or prolonged exposure may result in eye corrosion with corneal or conjunctival ulceration. Contact with aqueous concentrations of greater than 10% may result in eye corrosion with corneal or conjunctival ulceration with possible irreversible eye damage, including blindness.

Overexposure by inhalation may cause irritation of the upper respiratory passages or nonspecific discomfort such as nausea, headache, or weakness. Higher inhalation exposures may lead to temporary lung irritation effects with cough, discomfort, difficulty breathing, or shortness of breath; or fatality from gross overexposure. Ingestion may cause irritation of the gastrointestinal tract with upper abdominal pain, "heartburn", nausea, vomiting, and diarrhea. "Coffee grounds" vomitus and black tarry stools may occur as a result of gastrointestinal tract bleeding. Additional effects from overexposure include red blood cell destruction, or gas embolism.

As a consequence of the potential of serious injury through misuse of hydrogen peroxide, by direct human consumption, Health Canada has directed that hydrogen peroxide (≥ 35%) be classified as (acutely) Toxic under its WHMIS program for occupational health hazard awareness.

When used as colonic lavage, hydrogen peroxide has caused gas embolism and gangrene of the intestine at concentrations down to 0.75%. Gross overexposure by ingestion may be fatal.

(HAZARDS IDENTIFICATION – Continued)

Individuals with preexisting diseases of the skin, eyes, or lungs may have increased susceptibility to the toxicity of excessive exposures.

Carcinogenicity Information

None of the components present in this material at concentrations equal to or greater than 0.1% are listed by IARC, NTP, OSHA or ACGIH as a carcinogen.

FIRST AID MEASURES

First Aid

INHALATION

If inhaled, immediately remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.

SKIN CONTACT

In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Call a physician. Wash contaminated clothing and shoes promptly and thoroughly.

EYE CONTACT

In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Call a physician.

INGESTION

If swallowed, do not induce vomiting. Give large quantities of water. Never give anything by mouth to an unconscious person. Call a physician.

Notes to Physicians:

If swallowed, large amounts of oxygen may be released quickly. The distention of the stomach or esophagus may be injurious. Insertion of a gastric tube may be advisable.

FIRE FIGHTING MEASURES

Flammable Properties

Will not burn, but decomposition, which may be caused by heat or contamination will release oxygen which will increase the explosive limit range and burning rate of flammable vapors.

(FIRE FIGHTING MEASURES - Continued)

Fire and Explosion Hazards:

Strong oxidizer. Contact with clothing or combustibles may cause fire. Effect may be delayed. Contact with organic liquids or vapors may cause immediate fire or explosion, especially if heated. Under certain circumstances, detonation may be delayed. Oxygen release from hydrogen peroxide may force organic or hydrogen vapors into an explosive range. Follow appropriate National Fire Protection Association (NFPA) codes.

Flash Point:	Not Applicable....non-flammable
Upper and Lower Flammability Limits:	Not Applicable....non-flammable
Auto-Ignition Temperature:	Not Applicable....non-flammable

Explosion Data	- sensitivity to mechanical impact:	Not Applicable
	- sensitivity to static discharge:	Not Applicable

Extinguishing Media

Use only water.

Fire Fighting Instructions

Flood with water. Cool tank/container with water spray.

Wear full protective clothing (rubber suit and boots) including chemical splash goggles or hood and self-contained breathing apparatus.

ACCIDENTAL RELEASE MEASURES

Safeguards (Personnel)

NOTE: Review FIRE FIGHTING MEASURES and HANDLING (PERSONNEL) sections before proceeding with clean-up. Use appropriate PERSONAL PROTECTIVE EQUIPMENT during clean-up.

Accidental Release Measures

Comply with Federal, State and local regulations on reporting releases of wastes. Hold in a diked area until hydrogen peroxide decomposes. May be destroyed with sodium metabisulfite or sodium sulfite (1.9 lbs. SO_2 equivalent per lb. of peroxide) after diluting to 5-10%. Develop acceptable disposal plan in conjunction with necessary regulatory authorities. Disposal method may include dilution to non-impact concentration and drainage to appropriate chemical sewer or waste treatment system.

The Extremely Hazardous Substance List Reportable Quantity for >52% Hydrogen Peroxide is 1 lb.

HANDLING AND STORAGE

(ACCIDENTAL RELEASE MEASURES – Continued)

If Hydrogen Peroxide (20 to 60%) is spilled and not recovered, or is recovered as a waste for treatment or disposal, the CERCLA Reportable Quantity is 100 lbs. (release of an Unlisted Hazardous Waste characteristic of Ignitibility). Combustible materials exposed to hydrogen peroxide should be immediately submerged in or rinsed with large amounts of water to ensure that all hydrogen peroxide is removed. Residual hydrogen peroxide that is allowed to dry (upon evaporation hydrogen peroxide can concentrate) on organic materials such as paper, fabrics, cotton, leather, wood or other combustibles can cause the material to ignite and result in a fire.

Handling (Personnel)

Use extreme care when attempting any reactions because of fire and explosion potential (immediate or delayed). Conduct all initial experiments on a small scale and protect personnel with adequate shielding as the reactions are unpredictable and may be delayed, and may be affected by impurities, contaminants, temperature, etc. Do not get in eyes. Do not taste or swallow. Avoid contact with skin and clothing. Wash thoroughly after handling. Avoid contact with flammable or combustible materials. Avoid contamination from any source including metals, dust, and organic materials. Never use pressure to empty drums; container is not a pressure vessel. In the event of an accident where large volumes of hydrogen peroxide might come into contact with external fires or with incompatible chemicals, a one-half mile area from the incident should be evacuated.

Storage

Store in a properly vented container or in approved bulk storage facilities. Do not block vent; Do not store on wooden pallets. Do not store where contact with incompatible materials could occur, even with a spill. (See "Hazardous Reactivity".) have water source available for diluting. Do not add any other product to container. Never return used or unused peroxide to container, instead dilute with plenty of water and discard. Rinse empty containers thoroughly with clean water before discarding. (See "Waste Disposal".)

EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls

Use sufficient ventilation to keep employee exposure below recommended exposure limits.

Personal Protective Equipment

EYE/FACE PROTECTION

Wear coverall chemical splash goggles. In addition, where the possibility exists for eye or face contact due to splashing or spraying of material, wear chemical splash goggles/full-length face shield combination.

RESPIRATORS

Where there is a potential for airborne exposure in excess of applicable limits, wear NIOSH/MSHA approved respiratory protection.

(EXPOSURE CONTROL/PERSONAL PROTECTION – Continued)

PROTECTIVE CLOTHING

Where there is potential for skin contact, have available and wear as appropriate: impervious gloves, apron, pants, jacket, hood, and boots; or totally encapsulating chemical suit with breathing air supply. Permeation data supplied by vendors indicate that impervious materials such as natural rubber, natural rubber plus neoprene, nitrile, or polyvinylchloride afford adequate protection.

Do not wear leather gloves or leather shoes (uppers or soles) because they can ignite following contact with peroxide. Cotton clothing can also ignite. This effect may be within minutes, or delayed. Clothing fires and skin damage occur less quickly with 50% or lower hydrogen peroxide than with 70% material, but adequate personal protection is essential for all industrial concentrations. Protective skin creams offer no protection from hydrogen peroxide and should not be used. Completely submerge hydrogen peroxide contaminated clothing or other materials in water prior to drying. Residual hydrogen peroxide, if allowed to dry on materials such as paper, fabrics cotton, leather, wood or other combustibles can cause the material to ignite and result in a fire.

Exposure guidelines

Applicable Exposure Limits

HYDROGEN PEROXIDE
PEL (OSHA) : 1 ppm, 1.4 mg/m3 (90%) - 8 Hr TWA
TLV (ACGIH) : 1 ppm, 1.4 mg/m3, 8 Hr. TWA, A3

PHYSICAL AND CHEMICAL PROPERTIES

Physical Data

Evaporation Rate	:	>1
Vapor Density	:	Not Available
Solubility in Water	:	100 wt%
Solubility in Fat	:	Not Applicable
pH	:	<3
Form	:	Clear liquid
Color	:	Colorless
Odor	:	Slightly pungent, irritating
Odor Threshold	:	Not Available

(PHYSICAL AND CHEMICAL PROPERTIES - Continued)

Properties	Hydrogen Peroxide Concentration, wt%				
	20	30	35	50	60
Boiling Point @ 1 atm, 760 mmHg °C	103	105	108	114	119
°F	217	220	226	237	246
Melting Point °C	-14.6	-25.0	-33.0	-52.2	-55.5
°F	5.7	-13.0	-27.4	-62.0	-67.9
Specific Gravity gm @ 25°C (77°F)	1.07	1.11	1.13	1.19	1.24
Vapor Pressure mmHg @ 25°C (77°F)	20.6	19.0	17.4	13.5	10.7

STABILITY AND REACTIVITY

Chemical Stability

Unstable with heat or contamination; liberation of oxygen gas may result in dangerous pressures. (See "Decomposition", below.)

Incompatibility with Other Materials

Incompatible with most flammables/combustibles (see "Fire and Explosion Hazards") as well as cyanides, nitric acid, potassium permanganate, and many other oxidizing and reducing agents. Mixtures with both organics and some acids may be especially reactive.

Decomposition

Contamination or heat may cause self-accelerating exothermic decomposition with oxygen gas and steam release that can cause dangerous pressures. May react dangerously with rust, dust, dirt, iron, copper, heavy metals or their salts (such as mercuric oxide or chloride), alkalis, and with organic materials (especially vinyl monomers).

Polymerization

Polymerization will not occur.

TOXICOLOGICAL INFORMATION

Animal Data

Inhalation 4-hour LC50:	>0.2 ppm in rats (50% H_2O_2)
Skin absorption LD50 :	>2000 mg/kg in rabbits (35% H_2O_2)
Oral LD50 :	1232 mg/kg in rats (35% H_2O_2) 805 mg/kg in rats (70% H_2O_2)

(TOXICOLOGICAL INFORMATION – Continued)

At aqueous concentrations of less than 50% hydrogen peroxide skin irritation occurs, but at greater concentrations hydrogen peroxide is corrosive to the skin. Concentrations less than 5% in aqueous solutions are eye irritants; solutions between 5% and 10% range from severe eye irritants to being corrosive; concentrations greater than 10% are corrosive to the eye. The compound is not a skin sensitizer in animals.

Repeated inhalation exposures produced nasal discharge, bleached hair, and respiratory tract congestion with some deaths occurring in rats and mice exposed to concentrations greater than 67 ppm. Dogs exposed by inhalation to 7 ppm for 6 months had lung and skin irritation.

The effects from single high oral doses include convulsions. Repeated administration of the compound in the diet of animals resulted in growth inhibition, reduced weight gain, abnormal liver function, ulcers, and discoloration of the stomach lining with swelling. Long-term administration to mice in the drinking water resulted in gastric erosions and duodenal hyperplasia.

One study by skin application suggested no carcinogenic activity. Results of an ingestion study with mice suggested that hydrogen peroxide might be carcinogenic. However, the FDA and other organizations have reviewed this study and concluded there is insufficient evidence that hydrogen peroxide is carcinogenic. An unpublished, long-term study with rats revealed no evidence of carcinogenicity. Female rats treated with 10% hydrogen peroxide produced offspring of lower body weight and some structural abnormalities, but these changes were attributed to maternal toxicity. Hydrogen peroxide produced genetic damage to bacterial and mamalian cells in culture, but one study in animals indicated it did not produce genetic damage. Limited tests in animals demonstrate no reproductive toxicity.

ECOLOGICAL INFORMATION

Ecotoxicological Information

Aquatic Toxicity

96-hour LC50, catfish:	37.4 mg/L

DISPOSAL CONSIDERATIONS

Waste Disposal

Comply with Federal, State, and local regulations. If approved, may be diluted and drained to a municipal sewer or waste treatment plant. May be diluted and drained through a scrap metal pit (iron, copper, etc.) to reduce peroxide concentration. Hydrogen peroxide may be an RCRA regulated hazardous waste upon disposal due to the oxidizing characteristic under the ignitability category.

TRANSPORTATION INFORMATION

Shipping Information - U.S.A.

DOT(49CFR)/IMO

Proper Shipping Name : Hydrogen Peroxide, aqueous solutions
Hazard Class : 5.1
UN No. : 2014
DOT/IMO Label : OXIDIZER, CORROSIVE
Subsidiary Hazard Class : 8
Packing Group : II

Shipping Containers: Tank Railcars.
Tank Trailers.

ISO (Sea) Tanks.

Drums I - not handled directly by Kemira
Bottles I

Shipping Information - Canada

TDG Act

Proper Shipping Name : Hydrogen Peroxide Aqueous Solutions
Class : 5.1 (8)
Packing Group : II
UN # : 2014

TMC CHEMICALS, INCORPORATED

P.O. BOX 5430
PARSIPPANY, NJ 07054

PHONE: 973-560-1400
FAX: 973-560-0400

MATERIAL SAFETY DATA SHEET

SECTION 1 - MATERIAL IDENTIFICATION

PRODUCT NAME	ISOTEC^{SM} Catalyst Series 4260 Component-A Powder Mix

ISOTEC^{SM} is a registered service mark of In-Situ Oxidative Technologies, Inc.

MANUFACTURER	TMC Chemicals, Inc. P.O. Box 5430 Parsippany, NJ 07054
EMERGENCY TELEPHONE NUMBER(S)	(973) 560-1400 (Northern NJ) (609) 275-8500 (Southern NJ)
DATE PREPARED:	January 1996 (Revised, 1/04)
C.A.S. CHEMICAL NAME	Not Applicable (Mixture)
SYNONYMS	None
CHEMICAL FAMILY	Not Applicable
EMPIRICAL FORMULA	MIXT
INTENDED USE	Catalyst

Catalyst is a mixture that has been tested as a whole in determining hazards

SECTION 2 - INGREDIENTS

CAS Number and Chemical Name	%	OSHA ACGIH PEL/TLV-TWA ppm - mg/M^3	ACGIH STEL-TWA ppm - mg/M^3
Catalyst is a trade secret	100	OSHA = None NIOSH = 1 mg/m^3	Oral LD50 Not Evaluated (1510 mg/m^3 Rat)

Catalyst is not listed as a known or suspect carcinogen by NTP or IARC

SECTION 3 - HEALTH HAZARDS

EMERGENCY OVERVIEW

Applicable properties are relevant to the mixture as a whole when certain proprietary ingredients present at their highest concentrations. Please note that the effects are normally lower for a typical mixture with smaller concentrations of these ingredients present.

ROUTES OF EXPOSURE

Inhalation, Skin Contact, Ingestion

EXPOSURE STANDARDS

See Section 2 for exposure standards on ingredients

HEALTH HAZARDS

May irritate eyes, skin and mucous membranes; harmful if inhaled or swallowed

TARGET ORGANS

Eyes, respiratory tract

SIGNS AND SYMPTOMS OF EXPOSURE (Acute and Chronic effects)

Irritant to mucous membranes and upper respiratory tract; may cause eye and skin irritation, stomach ache, breathing difficulty

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE

None known

IRRITATION EFFECTS DATA

Not Evaluated

ACUTE TOXICITY EFFECTS DATA

Oral LD50 - Not Evaluated (1510 mg/m^3 Rat)
Dermal LD50 - Not Evaluated

OTHER ACUTE EFFECTS

Not Evaluated

CHRONIC/SUBCHRONIC DATA

Not Evaluated

SECTION 4 - FIRST AID

EYE CONTACT

Hold eyelids apart and immediately flush eyes with plenty of water for at least 15 minutes. Call a physician.

SKIN CONTACT

Wash affected area immediately with soap and water.

INHALATION

In case of inhalation or suspected inhalation, move patient at once to fresh air and call a physician. Keep patient absolutely quiet. If breathing has stopped or is labored, give assisted respiration (e.g., mouth-to-mouth). Supplemental oxygen may be indicated.

INGESTION

If swallowed, call a physician immediately. Induce vomiting or remove stomach contents by gastric suction only as directed by medical personnel. Wash mouth with plenty of water. Never give anything by mouth to an unconscious person.

SECTION 5 - FIRE AND EXPLOSION DATA

CHARACTERISTICS:

Flash Point	None
Upper Explosive Limit (UEL)	Not Applicable
Lower Explosive Limit (LEL)	Not Applicable
Autoignition Temperature	Not Applicable
Flash Point Method(s)	None
Unusual Fire & Explosion Hazards	None
Fire Hazard Classification (OSHA/NFPA)	None

EXTINGUISHING MEDIA

In case of fire, flood with water.

SPECIAL FIRE FIGHTING PROCEDURES

Firefighters should wear butyl rubber boots, gloves, body suit and self-containing breathing apparatus. Use water spray to cool all affected containers. Avoid skin contact. Contain runoff water in dikes. Prevent stream contamination. Expended liquids from fire fighting should be diverted to an active sanitary sewer line.

UNUSUAL FIRE AND EXPLOSION HAZARDS

May emit sulfur oxide vapors under burning conditions. See Section 6 for hazardous combustion products.

SECTION 6 - REACTIVITY DATA

CHEMICAL STABILITY

Stable

INCOMPATIBILITIES

Avoid mixing powder with strong oxidizing agents and alkalies

CONDITIONS TO AVOID

Contact with combustible materials, heat

HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS

Sulfur oxide vapors, such as SO_2 and SO_3

HAZARDOUS POLYMERIZATON

Will not occur

NFPA Reactivity Rating

None

SECTION 7 - SPILL, LEAK AND WASTE DISPOSAL INFORMATION

CLEAN-UP PROCEDURES

Sweep up and repackage or place in receptacle for future disposal.

OTHER EMERGENCY ADVISE

Avoid eye and skin contact. Wear protective clothing including gloves, safety goggles, breathing mask and coveralls when handling. Stored materials should be placed in a dry and reasonably temperature area, preferably below 75^{o}F.

WASTE DISPOSAL

Remove to properly designated landfill. Observe all federal, state and local environmental regulations.

ENVIRONMENTAL EFFECTS

Data not yet available

SECTION 8 - PERSONAL PROTECTION/EXPOSURE CONTROLS

EYE PROTECTION

Splash proof goggles.

HAND PROTECTION

Impermeable gloves made of Nitrile or rubber.

RESPIRATORY PROTECTION

Wear appropriate NIOSH/MSHA-approved full-face respirator with HEPA cartridges for protection against excessive particulate matter/ dust

PROTECTIVE CLOTHING

Long sleeved clothing (e.g. cotton coveralls or Tyvek). Do not wear short trousers

ENGINEERING CONTROLS

Avoid drafts that may disperse material beyond the work area. Use light water spray for dust suppression

WORK AND HYGIENIC PRACTICES

Provide readily accessible eye wash stations. Wash at the end of each work shift and before eating, smoking or using the toilet

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SECTION 9 - STORAGE AND HANDLING

STORAGE

Keep container tightly closed and dry. Keep in a cool place. Do not store next to strong oxidizers (e.g. hydrogen peroxide). Store approximately 10 feet away from oxidizers.

HANDLING

Do not inhale. Avoid contact with skin and eyes.

OTHER PRECAUTIONS:

Carefully read instructions before handling this material. Be sure that all engineering and personal protective equipment is in working order.

MATERIAL SAFETY DATA SHEET

SECTION 10 - PHYSICAL AND CHEMICAL PROPERTIES

PHYSICAL FORM	Powder
COLOR	Light Green
ODOR	None

TYPICAL PHYSICAL DATA

pH (10% aqueous)	3.5-3.9
VAPOR PRESSURE (mm Hg)	0
VAPOR DENSITY (Air = 1)	Not Applicable
BOILING POINT	Decomposition at 300^{o}C
FREEZING/MELTING POINT	Not Applicable
SOLUBILITY IN WATER	57% by weight @ 158^{o}
SPECIFIC GRAVITY (Water = 1)	1.899 @ 14^{o}/ 8^{o}C
EVAPORATION RATE (Butylacetate = 1)	Non Volatile
VISCOSITY (CPS)	Not Evaluated

SECTION 11 - TRANSPORTATION INFORMATION

UN No.	None Allocated
DOT SHIPPING NAME	No Data
IMO SHIPPING NAME	No Data
LATA SHIPPING NAME	No Data

The information set forth above is based upon information which TMC Chemicals, Inc. believes to be accurate. No warranty, express or implied, is intended. The information is provided solely for your information and consideration and TMC Chemical, Inc. assumes no legal responsibility for use or reliance thereon.

TMC CHEMICALS,
INCORPORATED

P.O. BOX 5430 ***PHONE: 973-560-1400***
PARSIPPANY, NJ 07054 ***FAX: 973-560-0400***

MATERIAL SAFETY DATA SHEET

SECTION 1 - MATERIAL IDENTIFICATION

PRODUCT NAME	ISOTEC^{SM} Catalyst-4260 Chelopolychempremox-B-2

ISOTEC is a registered servicemark of In-Situ Oxidative Technologies, Inc.

MANUFACTURER	TMC Chemicals, Inc. P.O. Box 5430 Parsippany, NJ 07054
EMERGENCY TELEPHONE NUMBER(S)	(973) 560-1400 (Northern NJ) (609) 275-8500 (Southern NJ)
DATE PREPARED:	January 1996 (revised, 3/06)
C.A.S. CHEMICAL NAME	Mixture
SYNONYMS	None
CHEMICAL FAMILY	Not Applicable
EMPIRICAL FORMULA	MIXT
INTENDED USE	Catalyst

SECTION 2 - INGREDIENTS

CAS Number and Chemical Name	%	OSHA ACGIH PEL/TLV-TWA ppm - mg/M^3	ACGIH STEL-TWA ppm - mg/M^3
Catalyst is a trade secret	100	Not established	Not established

This product is not listed as a known or suspect carcinogen by NTP or IARC

SECTION 3 - HEALTH HAZARDS

EMERGENCY OVERVIEW

Applicable properties are relevant to the mixture as a whole when certain proprietary ingredients present at their highest concentrations. Please note that the effects are normally lower for a typical mixture with smaller concentrations of these ingredients present.

ROUTES OF EXPOSURE

Inhalation, Skin Contact, Ingestion

EXPOSURE STANDARDS

See Section 2 for exposure standards on ingredients

HEALTH HAZARDS

Eye and skin irritant, may be harmful if inhaled or swallowed

TARGET ORGANS

Kidney, Ureter, Bladder

SIGNS AND SYMPTOMS OF EXPOSURE (Acute and Chronic effects)

Irritant to mucous membranes and upper respiratory tract; may cause eye or skin irritation

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE

None Reported

IRRITATION EFFECTS DATA

Not Evaluated

ACUTE TOXICITY EFFECTS DATA

Oral LD50 - Not Evaluated (2150 mg/kg Rat)
Dermal LD50 - Not Evaluated

OTHER ACUTE EFFECTS

Not Evaluated

CHRONIC/SUBCHRONIC DATA

Not Evaluated

SECTION 4 - FIRST AID

EYE CONTACT

Hold eyelids apart and immediately flush eyes with plenty of water for at least 15 minutes. Call a physician.

SKIN CONTACT

Wash affected area immediately with soap and water.

INHALATION

In case of inhalation or suspected inhalation, move patient at once to fresh air and call a physician. Keep patient absolutely quiet. If breathing has stopped or is labored, give assisted respiration (e.g., mouth-to-mouth). Supplemental oxygen may be indicated.

INGESTION

If swallowed, call a physician immediately. Induce vomiting or remove stomach contents by gastric suction only as directed by medical personnel. Wash mouth with plenty of water. Never give anything by mouth to an unconscious person.

SECTION 5 - FIRE AND EXPLOSION DATA

CHARACTERISTICS:

Flash Point	Not Evaluated
Upper Explosive Limit (UEL)	Not Applicable
Lower Explosive Limit (LEL)	Not Applicable
Autoignition Temperature	Not Evaluated
Flash Point Method(s)	Not Specified
Fire Hazard Classification (OSHA/NFPA)	None

EXTINGUISHING MEDIA

In case of fire, flood with water.

SPECIAL FIRE FIGHTING PROCEDURES

Firefighters should wear butyl rubber boots, gloves, body suit and self containing breathing apparatus. Use water spray to cool all affected containers. Avoid skin contact. Contain runoff water in dikes. Prevent stream contamination. Expended liquids from fire fighting should be diverted to an active sanitary sewer line.

UNUSUAL FIRE AND EXPLOSION HAZARDS

May emit oxides of carbon, nitrogen, and sulfur under burning conditions.

SECTION 6 - REACTIVITY DATA

CHEMICAL STABILITY

Stable

INCOMPATIBILITIES

Strong Oxidizing Agents. Do not mix with pure oxidizing agents

CONDITIONS TO AVOID

Contact with combustible materials, heat

HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS

Oxides of carbon, nitrogen and sulfur.

HAZARDOUS POLYMERIZATON

Will not occur

NFPA Reactivity Rating

None

SECTION 7 - SPILL, LEAK AND WASTE DISPOSAL INFORMATION

CLEAN-UP PROCEDURES

Do not mix combustible substances (e.g., sawdust) with spilled material. Do not raise dust while sweeping.

OTHER EMERGENCY ADVISE

Avoid eye and skin contact. Wear protective clothing.

WASTE DISPOSAL

Sweep up, place in a bag and hold for waste disposal. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber. Observe all federal, state and local environmental regulations.

ENVIRONMENTAL EFFECTS

Data not yet available

SECTION 8 - PERSONAL PROTECTION/EXPOSURE CONTROLS

EYE PROTECTION

Splash-proof goggles.

HAND PROTECTION

Impermeable gloves made of Nitrile or rubber.

RESPIRATORY PROTECTION

Wear appropriate NIOSH/MSHA-approved full-face respirator with HEPA cartridges for protection against particulate matter/ dust.

PROTECTIVE CLOTHING

Long sleeved clothing such as cotton coveralls or Tyvek.

ENGINEERING CONTROLS

Avoid drafts that may disperse material beyond the work area. Use light water spray for dust suppression.

WORK AND HYGIENIC PRACTICES

Provide readily accessible eyewash stations. Wash at the end of each work shift and before eating, smoking or using the toilet.

SECTION 9 - STORAGE AND HANDLING

STORAGE

Keep container tightly closed and dry. Keep in a cool place. Do not store near strong oxidizers (e.g. hydrogen peroxide). Store at least 10 feet away.

HANDLING

Do not inhale. Avoid contact with skin and eyes.

OTHER PRECAUTIONS:

Carefully read instructions before handling this material. Be sure that all engineering and personal protective equipment is in working order.

MATERIAL SAFETY DATA SHEET

SECTION 10 - PHYSICAL AND CHEMICAL PROPERTIES

PHYSICAL FORM	Powder
COLOR	White
ODOR	None

TYPICAL PHYSICAL DATA

pH (10% aqueous solution)	~ 5
VAPOR PRESSURE (mm Hg)	Non-Volatile
VAPOR DENSITY (Air = 1)	Non-Volatile
BOILING POINT	Not Applicable
FREEZING/MELTING POINT	~ 240°C
SOLUBILITY IN WATER	Soluble
SPECIFIC GRAVITY (Water = 1)	Not Evaluated
EVAPORATION RATE (Butylacetate = 1)	Non-Volatile
VISCOSITY (CPS)	Not Evaluated

SECTION 11 - TRANSPORTATION INFORMATION

UN No.	None Allocated
DOT SHIPPING NAME	No Data
IMO SHIPPING NAME	No Data
LATA SHIPPING NAME	No Data

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MATERIAL SAFETY DATA SHEET

SECTION 1 - MATERIAL IDENTIFICATION

PRODUCT NAME	ISOTEC^{SM} Catalyst-4260 Chelopolychempremox-B-4

ISOTEC is a registered servicemark of In-Situ Oxidative Technologies, Inc.

MANUFACTURER	TMC Chemicals, Inc. P.O. Box 5430 Parsippany, NJ 07054
EMERGENCY TELEPHONE NUMBER(S)	(973) 560-1400 (Northern NJ) (609) 275-8500 (Southern NJ)
DATE PREPARED:	January 1996 (revised, 3/06)
C.A.S. CHEMICAL NAME	Mixture
SYNONYMS	None
CHEMICAL FAMILY	Not Applicable
EMPIRICAL FORMULA	MIXT
INTENDED USE	Catalyst

SECTION 2 - INGREDIENTS

CAS Number and Chemical Name	%	OSHA ACGIH PEL/TLV-TWA ppm - mg/M^3	ACGIH STEL-TWA ppm - mg/M^3
Catalyst is a trade secret	100	Not established	Not established

This product is not listed as a known or suspect carcinogen by NTP or IARC

SECTION 3 - HEALTH HAZARDS

EMERGENCY OVERVIEW

Applicable properties are relevant to the mixture as a whole when certain proprietary ingredients present at their highest concentrations. Please note that the effects are normally lower for a typical mixture with smaller concentrations of these ingredients present.

ROUTES OF EXPOSURE

Inhalation, Skin Contact, Ingestion

EXPOSURE STANDARDS

See Section 2 for exposure standards on ingredients

HEALTH HAZARDS

Eye and skin irritant, may be harmful if inhaled or swallowed

TARGET ORGANS

Kidney, Ureter, Bladder

SIGNS AND SYMPTOMS OF EXPOSURE (Acute and Chronic effects)

Irritant to mucous membranes and upper respiratory tract; may cause eye or skin irritation

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE

None Reported

IRRITATION EFFECTS DATA

Not Evaluated

ACUTE TOXICITY EFFECTS DATA

Oral LD50 - Not Evaluated (1000-2000 mg/kg Rat)
Dermal LD50 - Not Evaluated

OTHER ACUTE EFFECTS

Not Evaluated

CHRONIC/SUBCHRONIC DATA

Not Evaluated

SECTION 4 - FIRST AID

EYE CONTACT

Hold eyelids apart and immediately flush eyes with plenty of water for at least 15 minutes. Call a physician.

SKIN CONTACT

Wash affected area immediately with soap and water.

INHALATION

In case of inhalation or suspected inhalation, move patient at once to fresh air and call a physician. Keep patient absolutely quiet. If breathing has stopped or is labored, give assisted respiration (e.g., mouth-to-mouth). Supplemental oxygen may be indicated.

INGESTION

If swallowed, call a physician immediately. Induce vomiting or remove stomach contents by gastric suction only as directed by medical personnel. Wash mouth with plenty of water. Never give anything by mouth to an unconscious person.

SECTION 5 - FIRE AND EXPLOSION DATA

CHARACTERISTICS:

Flash Point	Not Evaluated
Upper Explosive Limit (UEL)	Not Applicable
Lower Explosive Limit (LEL)	Not Applicable
Autoignition Temperature	Not Evaluated
Flash Point Method(s)	Not Specified
Fire Hazard Classification (OSHA/NFPA)	None

EXTINGUISHING MEDIA

In case of fire, flood with water.

SPECIAL FIRE FIGHTING PROCEDURES

Firefighters should wear butyl rubber boots, gloves, body suit and self containing breathing apparatus. Use water spray to cool all affected containers. Avoid skin contact. Contain runoff water in dikes. Prevent stream contamination. Expended liquids from fire fighting should be diverted to an active sanitary sewer line.

UNUSUAL FIRE AND EXPLOSION HAZARDS

May emit oxides of carbon, nitrogen, and sulfur under burning conditions.

SECTION 6 - REACTIVITY DATA

CHEMICAL STABILITY

Stable

INCOMPATIBILITIES

Strong Oxidizing Agents. Do not mix with pure oxidizing agents

CONDITIONS TO AVOID

Contact with combustible materials, heat

HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS

Oxides of carbon, nitrogen and sulfur.

HAZARDOUS POLYMERIZATON

Will not occur

NFPA Reactivity Rating

None

SECTION 7 - SPILL, LEAK AND WASTE DISPOSAL INFORMATION

CLEAN-UP PROCEDURES

Do not mix combustible substances (e.g., sawdust) with spilled material. Do not raise dust while sweeping.

OTHER EMERGENCY ADVISE

Avoid eye and skin contact. Wear protective clothing.

WASTE DISPOSAL

Sweep up, place in a bag and hold for waste disposal. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber. Observe all federal, state and local environmental regulations.

ENVIRONMENTAL EFFECTS

Data not yet available

SECTION 8 - PERSONAL PROTECTION/EXPOSURE CONTROLS

EYE PROTECTION

Splash-proof goggles.

HAND PROTECTION

Impermeable gloves made of Nitrile or rubber.

RESPIRATORY PROTECTION

Wear appropriate NIOSH/MSHA-approved full-face respirator with HEPA cartridges for protection against particulate matter/ dust.

PROTECTIVE CLOTHING

Long sleeved clothing such as cotton coveralls or Tyvek.

ENGINEERING CONTROLS

Avoid drafts that may disperse material beyond the work area. Use light water spray for dust suppression.

WORK AND HYGIENIC PRACTICES

Provide readily accessible eyewash stations. Wash at the end of each work shift and before eating, smoking or using the toilet.

SECTION 9 - STORAGE AND HANDLING

STORAGE

Keep container tightly closed and dry. Keep in a cool place. Do not store near strong oxidizers (e.g. hydrogen peroxide). Store at least 10 feet away.

HANDLING

Do not inhale. Avoid contact with skin and eyes.

OTHER PRECAUTIONS:

Carefully read instructions before handling this material. Be sure that all engineering and personal protective equipment is in working order.

MATERIAL SAFETY DATA SHEET

SECTION 10 - PHYSICAL AND CHEMICAL PROPERTIES

PHYSICAL FORM	Powder
COLOR	White
ODOR	None

TYPICAL PHYSICAL DATA

pH (10% aqueous solution)	~ 11
VAPOR PRESSURE (mm Hg)	Non-Volatile
VAPOR DENSITY (Air = 1)	Non-Volatile
BOILING POINT	Not Applicable
FREEZING/MELTING POINT	~ 300^{o}C
SOLUBILITY IN WATER	Soluble
SPECIFIC GRAVITY (Water = 1)	Not Evaluated
EVAPORATION RATE (Butylacetate = 1)	Non-Volatile
VISCOSITY (CPS)	Not Evaluated

SECTION 11 - TRANSPORTATION INFORMATION

UN No.	None Allocated
DOT SHIPPING NAME	No Data
IMO SHIPPING NAME	No Data
LATA SHIPPING NAME	No Data

The information set forth above is based upon information which TMC Chemicals, Inc. believes to be accurate. No warranty, express or implied, is intended. The information is provided solely for your information and consideration and TMC Chemical, Inc. assumes no legal responsibility for use or reliance thereon.

TMC CHEMICALS, INCORPORATED

P.O. BOX 5430	*PHONE: 973-560-1400*
PARSIPPANY, NJ 07054	*FAX: 973-560-0400*

MATERIAL SAFETY DATA SHEET

SECTION 1 - MATERIAL IDENTIFICATION

PRODUCT NAME	ISOTEC^{SM} Stabilizer 0875

ISOTEC is a registered servicemark of In-Situ Oxidative Technologies, Inc.

MANUFACTURER	TMC Chemical, Inc. P.O. Box 5430 Parsippany, NJ 07054
EMERGENCY TELEPHONE NUMBER(S)	(973) 560-1400 (Northern NJ) (609) 275-8500 (Southern NJ)
DATE PREPARED:	JANUARY 1996 (Revised, 8/00)
C.A.S. CHEMICAL NAME	Not Applicable (Mixture)
SYNONYMS	None
CHEMICAL FAMILY	Not Applicable
EMPIRICAL FORMULA	MIXT
INTENDED USE	Stabilizing Agent

SECTION 2 - INGREDIENTS

CAS Number and Chemical Name	%	OSHA ACGIH PEL/TLV-TWA ppm - mg/M^3	ACGIH STEL-TWA ppm - mg/M^3
Stabilizer is a trade secret	100	Not stablished	Not established

This product is not listed as a known or suspect carcinogen by NTP or IARC

SECTION 3 - HEALTH HAZARDS

EMERGENCY OVERVIEW

ROUTES OF EXPOSURE

Inhalation, Skin Contact, Ingestion

EXPOSURE STANDARDS

No exposure standards have been established

HEALTH HAZARDS

Amount of respirable dust is low in the product; however, it may cause skin or eye irritation upon prolonged exposure. May be harmful if swallowed.

TARGET ORGANS

Skin and mucous membranes

SIGNS AND SYMPTOMS OF EXPOSURE (Acute and Chronic effects)

No published data on skin absorption, contact, inhalation or ingestion. Human industrial experience has shown no significant inhalation hazard nor skin irritation for low level long term exposure. May be a moderate irritant to unirrigated eyes and mildly irritating after irrigating eyes following overexposure.

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE

None reported

IRRITATION EFFECTS DATA

No Data

ACUTE TOXICITY EFFECTS DATA

Oral LD50 - No Data
Dermal LD50 - No Data

OTHER ACUTE EFFECTS

No Data

CHRONIC/SUBCHRONIC DATA

No Data

SECTION 4 - FIRST AID

EYE CONTACT

Hold eyelids apart and immediately flush eyes with plenty of water for at least 15 minutes. If irritation occurs and persists, call a physician.

SKIN CONTACT

Wash affected area immediately with soap and water.

INHALATION

In case of inhalation or suspected inhalation, move patient at once to fresh air.

INGESTION

Rinse mouth and dilute stomach contents with water or, preferably, with milk. Large doses may cause nausea, vomiting and diarrhea. Systematic oral toxicity is extremely rare and has consisted of acidosis and hypocalcemic tetany.

SECTION 5 - FIRE AND EXPLOSION DATA

CHARACTERISTICS:

Flash Point	None
Upper Explosive Limit (UEL)	None
Lower Explosive Limit (LEL)	None
Autoignition Temperature	No Data
Flash Point Method(s)	Not Applicable
Fire Hazard Classification (OSHA/NFPA)	None

EXTINGUISHING MEDIA

Product is noncombustible.

SPECIAL FIRE FIGHTING PROCEDURES

Not Applicable

UNUSUAL FIRE AND EXPLOSION HAZARDS

None

SECTION 6 - REACTIVITY DATA

CHEMICAL STABILITY

Stable

INCOMPATIBILITIES

None

CONDITIONS TO AVOID

None

HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS

None

HAZARDOUS POLYMERIZATON

Will not occur

NFPA Reactivity Rating

None

SECTION 7 - SPILL, LEAK AND WASTE DISPOSAL INFORMATION

CLEAN-UP PROCEDURES

Material should be swept up for salvage or disposal.

OTHER EMERGENCY ADVISE

Avoid eye and skin contact. Wear appropriate protective clothing.

WASTE DISPOSAL

This product does not present a danger or hazard for disposal. May be disposed of in a properly designated landfill if needed.

ENVIRONMENTAL EFFECTS

Aquatic Toxicity unknown

SECTION 8 - PERSONAL PROTECTION/EXPOSURE CONTROLS

EYE PROTECTION

Wear chemical goggles when airborne dust is anticipated.

HAND PROTECTION

Impermeable gloves.

RESPIRATORY PROTECTION

Wear appropriate NIOSH/MSHA-approved respirator for dust protection if release of the product into the work area is expected.

PROTECTIVE CLOTHING

Long sleeved clothing to reduce exposed skin area.

ENGINEERING CONTROLS

Avoid drafts that may disperse material beyond the work area.

WORK AND HYGIENIC PRACTICES

Provide readily accessible eye wash stations. Wash at the end of each work shift and before eating, smoking or using the toilet.

SECTION 9 - STORAGE AND HANDLING

STORAGE

Keep container tightly closed and dry. Keep in a cool place.

HANDLING

Do not inhale. Avoid contact with skin and eyes.

OTHER PRECAUTIONS:

Carefully read instructions before handling this material. Be sure that all engineering and personal protective equipment is in working order.

MATERIAL SAFETY DATA SHEET

SECTION 10 - PHYSICAL AND CHEMICAL PROPERTIES

PHYSICAL FORM	Solid
COLOR	White
ODOR	None

TYPICAL PHYSICAL DATA

pH (1% solution)	4.6
VAPOR PRESSURE (mm Hg)	Non-Volatile
VAPOR DENSITY (Air = 1)	Non-Volatile
BOILING POINT	Not Applicable
FREEZING/MELTING POINT	253° C
SOLUBILITY IN WATER	20% by weight @ 25°C
SPECIFIC GRAVITY (Water = 1)	1.2
EVAPORATION RATE (Butylacetate = 1)	Non-Volatile
VISCOSITY (CPS)	No Data

SECTION 11 - TRANSPORTATION INFORMATION

UN No. 1481	
DOT SHIPPING NAME	No Data
IMO SHIPPING NAME	No Data
LATA SHIPPING NAME	No Data

MATERIAL SAFETY DATA SHEET

Klozur® CR

MSDS Ref. No.: F18-44-9
Date Approved: 01/03/2008
Revision No.: 1

This document has been prepared to meet the requirements of the U.S. OSHA Hazard Communication Standard, 29 CFR 1910.1200 and Canada's Workplace Hazardous Materials Information System (WHMIS) requirements.

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1. PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME:	Klozur® CR
GENERAL USE:	For chemical oxidation and aerobic bioremediation, petroleum hydrocarbon remediation, creosote remediation and partially halogenated hydrocarbon remediation.

MANUFACTURER

FMC CORPORATION
FMC Peroxygens
1735 Market Street
Philadelphia, PA 19103
(215) 299-6000 (General Information)
msdsinfo@fmc.com (Email - General Information)

EMERGENCY TELEPHONE NUMBERS

(303) 595-9048 (Medical - U.S. - Call Collect)

For leak, fire, spill, or accident emergencies, call:
(800) 424-9300 (CHEMTREC - U.S.A. & Canada)

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2. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW:

- Odorless, off-white fine granular solid (may have separation or noticeable two-tone appearance).
- Oxidizer.
- Contact with combustibles may cause fire.
- Under fire conditions product may decompose releasing oxygen that intensifies fire.
- Decomposes in storage under conditions of moisture (water/water vapor) and/or excessive heat causing release of oxides of sulfur and oxygen that supports combustion. Decomposition could form a high temperature melt. See Section 10 ("Stability and Reactivity").
- Deluge container with water at safe distance or in protected area.
- May be severely irritating to the eyes.
- May be harmful if swallowed.

POTENTIAL HEALTH EFFECTS: Airborne dust may be irritating to eyes, nose, lungs, throat and skin upon contact. Exposure to high levels of dust may cause difficulty in breathing in sensitive persons.

3. COMPOSITION / INFORMATION ON INGREDIENTS

Chemical Name	CAS#	Wt.%	EC No.	EC Class
Proprietary Mixture			None	Not classified

COMMENTS: FMC is withholding the specific chemical identity under provision of the OSHA Hazard Communication Rule Trade Secrets (1910.1200(i)(1)). The specific chemical identity will be made available to health professionals in accordance with 29 CFR 1910.1200(i) (1) (2) (3) (4). This Material Safety Data Sheet provides information for employee training and hazard identification.

4. FIRST AID MEASURES

EYES: Immediately flush with water for at least 15 minutes, lifting the upper and lower eyelids intermittently. See a medical doctor or ophthalmologist immediately.

SKIN: Wash with plenty of soap and water. Get medical attention if irritation occurs and persists.

INGESTION: Rinse mouth with water. Dilute by giving 1 or 2 glasses of water. Do not induce vomiting. Never give anything by mouth to an unconscious person. See a medical doctor immediately.

INHALATION: Remove to fresh air. If breathing difficulty or discomfort occurs and persists, obtain medical attention.

NOTES TO MEDICAL DOCTOR: Direct contact with the eyes may have serious consequences; therefore, direct contact with eyes should be avoided. Contaminated external surfaces should be flooded with water, and direct eye contact deserves ophthalmologic evaluation. If ingested, gastrointestinal irritation but not caustic burns are to be expected; dilution with water indicated as may be gastric evacuation via emesis or lavage if large doses or severe irritation is evident.

5. FIRE FIGHTING MEASURES

EXTINGUISHING MEDIA: Deluge with plenty of water.

FIRE / EXPLOSION HAZARDS: Product is non-combustible. Under fire conditions, may decompose and release oxygen gas, which may intensify fire. Presence of water accelerates decomposition. Mixtures with polysulfide polymers may ignite.

FIRE FIGHTING PROCEDURES: Use flooding quantities of water. Use water spray to keep fire exposed containers cool. Do not use carbon dioxide or other gas filled fire extinguishers; they will have no effect on decomposition. Wear full protective clothing and self-contained breathing apparatus.

FLAMMABLE LIMITS: Non-combustible

SENSITIVITY TO IMPACT: Oxidizable materials can be ignited by grinding and may become explosive.

SENSITIVITY TO STATIC DISCHARGE: Not available

6. ACCIDENTAL RELEASE MEASURES

RELEASE NOTES: Confine and collect spill, put into an approved DOT container (do not return to original container) and isolate for disposal. Isolated material should be monitored for signs of decomposition (fuming / smoking). If spilled material is wet, dissolve with large quantities of water and dispose as a hazardous waste. Runoff to sewer may create fire or explosion hazard (do not flush powdered material into sewer). Dispose of wastes according to the method outlined in Section 13, "Disposal Considerations".

7. HANDLING AND STORAGE

HANDLING: Avoid contact by using personal protective equipment. Use respiratory protective equipment when release of airborne dust is expected. If compounded with organics or combustible materials be sure to exclude moisture. Use clean plastic or stainless steel scoops only.

STORAGE: Keep dry (reacts with moisture). Use first in, first out storage system. Store unopened in a cool, clean, dry place away from point sources of heat (e.g. steam pipes, radiant heaters, hot air vents or welding sparks). Keep container tightly closed when not in use. Avoid contamination of opened product. Avoid contact with reducing agents. In case of fire or decomposition (fuming / smoking) deluge with plenty of water to control decomposition. Fore storage, refer to NFPA Bulletin 430 on storage of liquid and solid oxidizing materials.

COMMENTS: VENTILATION: Provide mechanical general and/or local exhaust ventilation to prevent release of dust into work environment. Spills should be collected into suitable containers to prevent dispersion into the air. If ventilation is inadequate or not available, use dust respirator and eye protection.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

EXPOSURE LIMITS

Chemical Name	ACGIH	OSHA	Supplier
Proprietary Ingredient	5 mg/m^3 (TWA)	5 mg/m^3 (TWA)	5 mg/m^3 (TWA)
Proprietary Ingredient	0.1 mg/m^3 (TWA)		

ENGINEERING CONTROLS: Provide mechanical local exhaust ventilation to prevent release of dust into the work area. If release is expected use respiratory protection. Remove contaminated clothing immediately and wash before reuse.

PERSONAL PROTECTIVE EQUIPMENT

EYES AND FACE: Use cup type chemical goggles. Full face shield may be used.

RESPIRATORY: Use approved dust respirator with full face piece.

PROTECTIVE CLOTHING: Long sleeve shirt, impervious apron or clothing. Rubber or neoprene footwear.

GLOVES: Rubber or neoprene gloves. Thoroughly wash the outside of gloves with soap and water prior to removal. Inspect regularly for leaks.

9. PHYSICAL AND CHEMICAL PROPERTIES

ODOR:	Odorless
APPEARANCE:	Off-white fine granular solid
AUTOIGNITION TEMPERATURE:	Non-combustible
BOILING POINT:	No data available
COEFFICIENT OF OIL / WATER:	Not available
DENSITY / WEIGHT PER VOLUME:	(Bulk) 51.8 lbs/ft³ (loose)
EVAPORATION RATE:	Not applicable (Butyl Acetate = 1)
FLASH POINT:	Not applicable
MELTING POINT:	Decomposes on heating (About 275ºC)
OXIDIZING PROPERTIES:	Oxidizer
PERCENT VOLATILE:	Not applicable

pH:	11.2 slurry (1% solution)
SOLUBILITY IN WATER:	Sparingly soluble
SPECIFIC GRAVITY:	1 - 1.19 (5% to 30% slurries)
VAPOR DENSITY:	Not applicable (Air = 1)
VAPOR PRESSURE:	Not applicable

10. STABILITY AND REACTIVITY

CONDITIONS TO AVOID:	Heat (decomposes at 275ºC), moisture, reducing agents. Grinding with organics.
STABILITY:	Stable (decomposition could occur when exposed to heat or moisture)
POLYMERIZATION:	Will not occur
INCOMPATIBLE MATERIALS:	Grinding mixtures with organics (oxidizable materials can be ignited by grinding and may become explosive); heavy metals. Grinding mixtures with organics (oxidizable materials can be ignited by grinding and may become explosive); heavy metals. Acids, alkalis, halides (fluorides, chlorides, bromides and iodides), combustible materials, most metals and heavy metals, oxidizable materials, other oxidizers, reducing agents, cleaners, and organic or carbon containing compounds. Contact with incompatible materials can result in a material decomposition or other uncontrolled reactions.
HAZARDOUS DECOMPOSITION PRODUCTS:	Oxygen that supports combustion and oxides of sulfur, nitrogen, and calcium hydroxide.

COMMENTS: PRECAUTIONARY STATEMENT: Use of persulfates in chemical reactions requires appropriate precautions and design considerations for pressure and thermal relief. Decomposing persulfates will evolve large volumes of gas and/or vapor, can accelerate exponentially with heat generation, and create significant and hazardous pressures if contained and not properly controlled or mitigated. Use with alcohols in the presence of water has been demonstrated to generate conditions that require rigorous adherence to process safety methods and standards to prevent escalation to an uncontrolled reaction.

11. TOXICOLOGICAL INFORMATION

EYE EFFECTS: No data available for the formulation.
Proprietary Component: Severely irritating to unwashed eyes; minimally irritating to washed eyes (rabbit) [FMC Ref. I88-1053]
Proprietary Component: Non-irritating (rabbit) [FMC Ref. ICG/T-79.029]

SKIN EFFECTS: No data available for the formulation.
Proprietary Component: Non-irritating (rabbit) [FMC Ref. I88-1054]
Proprietary Component: Non-irritating (rabbit) [FMC Ref. ICG/T-79.029]

DERMAL LD_{50}: No data available for the formulation.
Proprietary Component: > 10 g/kg (rat) [FMC Ref. ICG/T-79.026 and 79.029]

ORAL LD_{50}: No data available for the formulation.
Proprietary Component: > 5 g/kg (rat) [FMC Ref. I88-1052]
Proprietary Component: 895 mg/kg (rat) [FMC Ref. ICG/T-79.029]

INHALATION LC_{50}: No data available for the formulation.
Proprietary Component: > 17 mg/l (1 h) (rat) [FMC Ref. ICG/T-79.026]
Proprietary Component: 5.1 mg/l (rat) [FMC Ref. I95-2017]

SENSITIZATION: No data available for the formulation.
Proprietary Component: (Skin) May be sensitizing to allergic persons. [FMC Ref. ICG/T-79.029]

TARGET ORGANS: Eyes, skin, respiratory passages

ACUTE EFFECTS FROM OVEREXPOSURE: May be harmful if swallowed. Direct contact with the eyes may have serious consequences; therefore, direct contact with eyes should be avoided. Airborne dusts may be irritating to the nose, throat and lungs, causing wheezing and/or shortness of breath. Dusts may also be irritating to eyes and skin upon contact; therefore, flooding of exposed areas with water is suggested.

CHRONIC EFFECTS FROM OVEREXPOSURE: No data available for the product. Sensitive persons may develop dermatitis and asthma. One of the proprietary components was fed to groups of male and female rats at 0, 300 and 3,000 ppm in the diet for 13 weeks, followed by 5,000 ppm for 5 weeks. Microscopic examination of tissues revealed some injury to the gastrointestinal tract at the highest dose (3,000 ppm) only. This effect is not unexpected for an oxidizer at high concentrations.

CARCINOGENICITY:

NTP:	Not listed
IARC:	Not listed
OSHA:	Not listed
OTHER:	Not Listed (ACGIH)

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12. ECOLOGICAL INFORMATION

ENVIRONMENTAL DATA: Biodegradability does not apply to inorganic substances. As indicated by chemical properties oxygen is released into the environment.

ECOTOXICOLOGICAL INFORMATION: No data available for the formulation.

Proprietary Component

Bluegill sunfish, 96-hour LC_{50} = 771 mg/L [FMC Study I92-1250]
Rainbow trout, 96-hour LC_{50} = 163 mg/L [FMC Study I92-1251]
Daphnia, 48-hour LC_{50} = 133 mg/L [FMC Study I92-1252]
Grass shrimp, 96-hour LC_{50} = 519 mg/L [FMC Study I92-1253]

13. DISPOSAL CONSIDERATIONS

DISPOSAL METHOD: Dissolve in water to allow the release of oxygen and dispose via a treatment system in accordance with governmental agencies regulations. Contact appropriate regulatory agency prior to disposal.

14. TRANSPORT INFORMATION

U.S. DEPARTMENT OF TRANSPORTATION (DOT)

PROPER SHIPPING NAME:	Oxidizing solid, n.o.s. (sodium persulfate, calcium peroxide)
PRIMARY HAZARD CLASS / DIVISION:	5.1 (Oxidizer)
UN/NA NUMBER:	UN 1479
PACKING GROUP:	II
LABEL(S):	5.1 (Oxidizer)
PLACARD(S):	5.1 (Oxidizer)
MARKING(S):	Oxidizing solid, n.o.s. (sodium persulfate, calcium peroxide), UN1479
ADDITIONAL INFORMATION:	Hazardous Substance/RQ: Not applicable 49 STCC Number: 4918733 This material is shipped in 45 lb. polyethylene pail with vented screw-on lid (approx 5.5 gallon)

INTERNATIONAL MARITIME DANGEROUS GOODS (IMDG)

PROPER SHIPPING NAME:	Oxidizing solid, n.o.s. (sodium persulfate, calcium peroxide)

INTERNATIONAL CIVIL AVIATION ORGANIZATION (ICAO) / INTERNATIONAL AIR TRANSPORT ASSOCIATION (IATA)

PROPER SHIPPING NAME:	Oxidizing solid, n.o.s. (sodium persulfate,

	calcium peroxide)
ADDITIONAL INFORMATION:	Combination packaging is recommended for air transport.

OTHER INFORMATION:

Place spilled product in suitable container and wash residue with plenty of water.
See Section 6 (Accidental Release Measures) above for additional instructions.

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15. REGULATORY INFORMATION

UNITED STATES

SARA TITLE III (SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT)

SECTION 311 HAZARD CATEGORIES (40 CFR 370):
Fire Hazard, Immediate (Acute) Health Hazard

SECTION 312 THRESHOLD PLANNING QUANTITY (40 CFR 370):
The Threshold Planning Quantity (TPQ) for this product, if treated as a mixture, is 10,000 lbs; however, this product contains the following ingredients with a TPQ of less than 10,000 lbs.: None

SECTION 313 REPORTABLE INGREDIENTS (40 CFR 372):
Not listed

CERCLA (COMPREHENSIVE ENVIRONMENTAL RESPONSE COMPENSATION AND LIABILITY ACT)

CERCLA DESIGNATION & REPORTABLE QUANTITIES (RQ) (40 CFR 302.4):
Proprietary component: Unlisted, RQ = 100 lbs., Ignitability

TSCA (TOXIC SUBSTANCE CONTROL ACT)

TSCA INVENTORY STATUS (40 CFR 710):
Listed

RESOURCE CONSERVATION AND RECOVERY ACT (RCRA)

RCRA IDENTIFICATION OF HAZARDOUS WASTE (40 CFR 261):
Waste Number: D001

CANADA

WHMIS (WORKPLACE HAZARDOUS MATERIALS INFORMATION SYSTEM):

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the MSDS contains all the information required by the Controlled Products Regulations.

Hazard Classification / Division:	C D2B D2A E
Domestic Substance List:	Listed (all components)

INTERNATIONAL LISTINGS

Proprietary Component
Australia (AICS): Listed
China: Listed
Japan (ENCS): (1)-190
Korea: KE-04597
Philippines (PICCS): Listed

Proprietary Component
Australia (AICS): Listed
China: Listed
Japan (ENCS): (1)-181
Korea: KE-04518
Philippines (PICCS): Listed

Proprietary Component
Australia (AICS): Listed
China: Listed
Japan (ENCS): (1)-1131
Korea: KE-12369
Philippines (PICCS): Listed

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16. OTHER INFORMATION

HMIS

Health	2
Flammability	0
Physical Hazard	1
Personal Protection (PPE)	J

Protection = J (Safety goggles, gloves, apron & combination dust & vapor respirator)

HMIS = Hazardous Materials Identification System

Degree of Hazard Code:
4 = Severe
3 = Serious
2 = Moderate
1 = Slight
0 = Minimal

NFPA

Health	2
Flammability	0
Reactivity	1
Special	OX

SPECIAL = OX (Oxidizer)

NFPA = National Fire Protection Association

Degree of Hazard Code:
4 = Extreme
3 = High
2 = Moderate
1 = Slight
0 = Insignificant

REVISION SUMMARY:
New MSDS.

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Olin
CHLOR ALKALI
PRODUCTS

MATERIAL SAFETY DATA

Sodium Hydroxide Solution, 50%

SECTION 1 – CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Δ

Manufacturer's name and address:

Olin Corporation – Chlor Alkali Products Division

CLEVELAND, TN OFFICE
490 Stuart Road NE
Cleveland, TN 37312-4918
U.S. • (423) 336-4850

Supplier's name and address:

Olin Canada, ULC d/b/a
Olin Chlor Alkali Products

MONTREAL, QC OFFICE
2020 University, Suite 2190
Montreal, Quebec H3A 2A5
Canada • (514) 397-6100

Product Name:	Sodium Hydroxide Solution, 50%		
CAS#:	1310-73-2	**Preparation date (M/D/Y):**	10/02/08
MSDS Code:	NaOH(50)-E	**Revision date (M/D/Y):**	02/08/11
Synonyms:	Caustic soda liquid 50%, Soda lye, Lye, Liquid Caustic, Sodium Hydrate		
Product Use:	Neutralizing agent, industrial cleaner, pulping and bleaching, soap manufacturing		

Emergency Contacts (24 hr.)

FOR INFORMATION REGARDING ON SITE CHEMICAL EMERGENCIES INVOLVING A SPILL OR LEAK, CALL

Δ **Canada: 1-800-567-7455**
U.S.: 1-800-424-9300 – CHEMTREC

SECTION 2 – COMPOSITION / INFORMATION ON INGREDIENTS

	Hazardous Ingredient(s)	% (w/w)	ACGIH	CAS NO.
Δ	Sodium Hydroxide	49 – 52	2 mg/m^3 (TLV-C)	1310-73-2

SECTION 3 – HAZARD IDENTIFICATION

Emergency Overview: Odorless, clear, non-volatile liquid. EXTREMELY CORROSIVE! Causes severe burns on contact. Can cause blindness, permanent scarring and death. Aerosols can cause lung injury – effects may be delayed. Highly reactive. Can react violently with water and numerous commonly encountered materials, generating enough heat to ignite nearby combustible materials. Contact with many organic and inorganic chemicals may cause fire or explosion. Reacts with some metals to liberate hydrogen gas, which can form explosive mixtures with air. Will not burn. Harmful to aquatic life. Read the entire MSDS for a more thorough evaluation of the hazards.

Potential Health Effects:

Δ **Routes of exposure:** Inhalation, skin contact, eye contact and ingestion.

Inhalation: Sodium hydroxide does not readily form a vapor and inhalation exposure is likely to occur as an aerosol. Due to its corrosive nature, sodium hydroxide aerosols could cause pulmonary edema (severe, life-threatening lung injury). The development of pulmonary edema may be delayed up to 48 hours after exposure. The early symptoms of pulmonary edema include shortness of breath and tightness in the chest.

Skin Contact: EXTREMELY CORROSIVE! Sodium hydroxide is capable of causing severe burns with deep ulceration and permanent scarring. It can penetrate to deeper layers of skin and corrosion will continue until removed. The severity of injury depends on the concentration (solutions) and the duration of exposure. Burns may not be immediately painful; onset of pain may be delayed minutes to hours. Several human studies and case reports describe the corrosive effects of sodium hydroxide. A 4% solution of sodium hydroxide, applied to a volunteer's arm for 15 to 180 minutes, caused damage which progressed from destruction of cells of the hard outer layer of the skin within 15 minutes to total destruction of all layers of the skin in 60 minutes. Solutions as weak as 0.12% have damaged healthy skin within 1 hour.

Eye Contact: EXTREMELY CORROSIVE! The severity of injury increases with the concentration, the duration of exposure, and the speed of penetration into the eye. Damage can range from severe irritation and mild scarring to blistering, disintegration, ulceration, severe scarring and clouding. Conditions, which affect vision such as glaucoma and cataracts, are possible late developments. In severe cases, there is progressive ulceration and clouding of eye tissue which may lead to permanent blindness.

Ingestion: EXTREMELY CORROSIVE! Severe pain; burning of the mouth, throat and esophagus; vomiting; diarrhea; collapse and possible death may result.

Chronic Effects: SKIN: Repeated or prolonged skin contact would be expected to cause drying, cracking, and inflammation of the skin (dermatitis).

Existing Medical Conditions Possibly Aggravated by Exposure: Asthma, bronchitis, emphysema and other lung diseases and chronic nose, sinus or throat conditions. Skin irritation may be aggravated in individuals with existing skin disorders.

Carcinogenicity: Sodium hydroxide is not classified as a carcinogen by ACGIH (American Conference of Governmental Industrial Hygienists) or IARC (International Agency for Research on Cancer), not regulated as a carcinogen by OSHA (Occupational Safety and Health Administration), and not listed as a carcinogen by NTP (National Toxicology Program).

Δ **Other important hazards:** Refer to TOXICOLOGICAL INFORMATION (Section 11) for additional information.

SECTION 4 – FIRST AID MEASURES

General: If you feel unwell, IMMEDIATELY seek medical advice (show this document).

Inhalation: Move victim to fresh air. If breathing is difficult, oxygen may be beneficial if administered by trained personnel, preferably on a doctor's advice. Give artificial respiration ONLY if breathing has stopped. Do not use mouth-to-mouth method if victim ingested or inhaled the substance: induce artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Give Cardiopulmonary Resuscitation (CPR) only if there is no pulse AND no breathing. Obtain medical attention IMMEDIATELY. Symptoms of pulmonary edema can be delayed up to 48 hours after exposure.

Skin Contact: Immediately flush skin with lukewarm water for at least 20 minutes, and up to 60 minutes if necessary. Under lukewarm water remove contaminated clothing, jewelry, and shoes. If irritation persists, repeat flushing. Obtain medical attention immediately. Discard contaminated clothing and shoes in a manner which limits further exposure.

Eye Contact: Immediately flush eyes with lukewarm water for at least 20 minutes, and up to 60 minutes if necessary. Hold eyelids open during flushing. If irritation persists, repeat flushing. Obtain medical attention IMMEDIATELY. Do not transport victim until the recommended flushing period is completed unless flushing can be continued during transport.

Ingestion: DO NOT INDUCE VOMITING. If victim is alert and not convulsing, rinse mouth and give as much water as possible to dilute material (8 to 10 oz. or 240 to 300 mL). If spontaneous vomiting occurs, have victim lean forward with head down, rinse mouth and administer more water. IMMEDIATELY transport victim to an emergency facility.

SECTION 5 – FIRE FIGHTING MEASURES

Flammability	Not applicable. Not combustible (does not burn).
Flash Point (method)	Not applicable.
Flammable Limits (Lower)	Not applicable
Flammable Limits (Upper)	Not applicable
Auto Ignition Temperature	Not applicable
Combustion and Thermal Decomposition Products	Sodium oxide fumes
Rate of Burning	Not applicable
Explosive Power	Not applicable
Sensitivity to Mechanical Impact	Not sensitive ; stable material
Sensitivity to Static Charge	Not applicable

Fire and Explosion Hazards: Sodium hydroxide will not burn or support combustion. The reaction of sodium hydroxide with water and a number of commonly encountered materials (see Section 10) can generate sufficient heat to ignite nearby combustible materials. Sodium hydroxide can react with metals, such as aluminum, tin and zinc, to form flammable hydrogen gas.

Extinguishing Media: Use extinguishing media suitable for the surrounding fire. If water is used, care should be taken, since it can generate heat and cause spattering if applied directly to sodium hydroxide.

Special Information: Evacuate area and fight fire from a safe distance or a protected location. Approach fire from upwind. If possible, isolate materials not involved in the fire and protect personnel. Move containers from fire area if it can be done without risk.

Water can be used with extreme caution to extinguish a fire in an area where sodium hydroxide is stored. The water must not come into contact with the sodium hydroxide. Water can be used in flooding quantities as a spray or fog to keep fire-exposed containers cool and absorb heat. At high temperatures, fuming may occur, giving off a strong, corrosive gas. Do not enter without wearing specialized protective equipment suitable for the situation.

Evacuation: If tank or tank truck involved in a fire, ISOLATE and consider evacuation of one-half (1/2) mile (800 meters) in all directions.

Fire Fighting Protective Equipment: Firefighter's normal protective clothing (Bunker Gear) will not provide adequate protection. Chemical resistant clothing (e.g. chemical splash suit) and positive pressure self-contained breathing apparatus (MSHA/NIOSH approved or equivalent) may be necessary.

NOTE: Also see "Section 10 - Stability and Reactivity"

SECTION 6 – ACCIDENTAL RELEASE MEASURES

Spills, Leaks, or Releases:

- Restrict access to area until completion of clean up. Ensure trained personnel conduct clean up. Ventilate area.
- Wear adequate personal protective equipment (See Section 8). Do not touch spilled material.
- Prevent entry into sewers or waterways.
- Land spill of sodium hydroxide: Solutions should be contained by diking with inert material, such as sand or earth. Solutions can be recovered or carefully diluted with water and cautiously neutralized with acids such as acetic acid or hydrochloric acid.
- Water spill: Neutralize with dilute acid.
- Comply with Federal, Provincial/State and local regulations on reporting releases.

Deactivating Chemicals: Weak acid solutions (acetic, hydrochloric or sulfuric acid).

Waste Disposal Methods: Dispose of waste material at an approved waste treatment/disposal facility, in accordance with applicable regulations. Do not dispose of waste with normal garbage or to sewer systems.

Note - Clean-up material may be a RCRA Hazardous Waste on disposal.
- Spills are subject to CERCLA reporting requirements: RQ = 1000 lbs. (454 kg).

SECTION 7 – HANDLING AND STORAGE

Precautions: EXTREMELY CORROSIVE! Have emergency equipment (for fires, spills, leaks, etc.) readily available. Ensure all containers are labeled. Wear appropriate Personal Protection Equipment *(Refer to Section 8)*. People working with this chemical should be properly trained regarding its hazards and its safe use.

Handling Procedures and Equipment: Use smallest possible amounts in designated areas with adequate ventilation. Keep containers closed when not in use. Empty containers may contain hazardous residues. Avoid generating mists. Transfer solutions using equipment, which is corrosion-resistant. Cautiously, transfer into sturdy containers made of compatible materials. Never return contaminated material to its original container. Considerable heat is generated when diluted with water. Proper handling procedures must be followed to prevent vigorous boiling, splattering or violent eruption of the diluted solution. Never add water to a sodium hydroxide solution. **ALWAYS ADD SODIUM HYDROXIDE TO WATER** and provide agitation. When mixing with water, stir small amounts in slowly. Use cold water to prevent excessive heat generation.

Storage Requirements: Store in a cool, dry, well-ventilated area. Keep containers tightly closed when not in use and when empty. Protect from damage. Store away from incompatible materials such as strong acids, nitroaromatic, nitroparaffinic or organohalogen compounds. See Section 10 for Incompatibles. Use corrosion-resistant structural materials and lighting and ventilation systems in the storage area. Containers made of nickel alloys are preferred. Steel containers are acceptable if temperatures are not elevated. Nickel is the preferred metal for handling this product. Plastics or plastic-lined steel, or FRP tanks of Derakane vinyl ester resin may be suitable. Container contents may develop pressure after prolonged storage. Drums may need to be vented. Trained personnel should only perform venting.

Storage Temperature: Avoid freezing. Do not expose sealed containers to temperatures above 40ºC (104ºF).

SECTION 8 – EXPOSURE CONTROLS / PERSONAL PROTECTION

PREVENTIVE MEASURES

Recommendations listed in this section indicate the type of equipment which will provide protection against over exposure to this product. Conditions of use, adequacy of engineering or other control measures, and actual exposures will dictate the need for specific protective devices at your workplace.

Engineering Controls: Local exhaust ventilation should be applied wherever there is an incidence of point source emissions or dispersion of regulated contaminants in the work area. Ventilation control of the contaminant as close to its point of generation is both the most economical and safest method to minimize personnel exposure to airborne contaminants. The most effective measures are the total enclosure of processes and the mechanization of handling procedures to prevent all personal contact.

PERSONAL PROTECTIVE EQUIPMENT

Maintain eye wash fountain and quick-drench facilities in work area. Detailed requirements for personal protective equipment should be established on a site-specific basis.

Eye Protection: Wear full face-shield and chemical safety goggles when there is potential for contact.

Skin Protection: Wear appropriate personal protective clothing to prevent skin contact.

Guidelines for sodium hydroxide solutions, 30-70%:

RECOMMENDED (resistance to breakthrough longer than 8 hours): Butyl rubber; natural rubber, neoprene rubber, nitrile rubber, polyethylene, polyvinyl chloride, Teflon™, Viton™, Saranex™, 4H™, Barricade™, CPF 3™, Responder™, Trellchem HPS™, Tychem 10000™.

NOT RECOMMENDED for use (resistance to breakthrough less than 1 hour): Polyvinyl alcohol.

Respiratory Protection:
Up to 10 mg/m^3: Supplied Air Respirator (SAR) operated in a continuous-flow mode, eye protection needed; or full face-piece respirator with high-efficiency particulate filter(s); or powered air-purifying respirator with dust and mist filter(s), eye protection needed; or full face-piece Self-Contained Breathing Apparatus (SCBA); or full face-piece SAR.

Emergency or Planned Entry into Unknown Concentrations or IDLH Conditions: Positive pressure, full face-piece SAR; or positive pressure, full face-piece SAR with an auxiliary positive pressure SAR.

ESCAPE: Full face-piece respirator with high-efficiency particulate filter(s); or escape-type SCBA.

EXPOSURE GUIDELINES

PRODUCT: Sodium hydroxide:

	ACGIH Ceiling Exposure Limit (TLV-C)	2 mg/m^3
Δ	OSHA PEL-TWA	2 mg/m^3
	NIOSH IDLH	10 mg/m^3
	NIOSH REL:	C 2 mg/m^3

SECTION 9 – PHYSICAL AND CHEMICAL PROPERTIES

Alternate Name(s)	Caustic soda liquid 50%, Soda lye, Lye, Liquid Caustic, Sodium Hydrate
Chemical Name	Sodium hydroxide
Chemical Family	Alkali hydroxide
Molecular Formula	NaOH
Molecular Weight	40.01
Δ **Physical State and Appearance**	Clear-to-slightly turbid liquid
Odor	Odorless
pH	14.0 (Aqueous solution: 5%)
Vapor Pressure	0.2 kPa (1.5 mm Hg) at 20 ºC (68˚F) (50% solution)
Vapor Density (Air = 1)	Not applicable
Boiling Point	140 ºC (284 ºF) (50% solution)
Freezing Point	12 ºC (53.6 ºF) (50% solution)
Solubility (Water)	Soluble in all proportions
Specific Gravity	1.53 (50% solution) 15.5 ºC (60°F)
Evaporation Rate	Not applicable
Viscosity (cp):	78.3 at 20 ºC (68˚F)
Bulk Density (lbs/cu ft):	95.5
Coefficient of Oil/Water Distribution	Essentially zero

SECTION 10 – STABILITY AND REACTIVITY

Chemical Stability: Stable at room temperature.

Hazardous Decomposition Products: Thermal decomposition: sodium oxide fumes

Conditions to Avoid: Water. Keep away from incompatibles.

Incompatibility with other Substances: Sodium hydroxide reacts vigorously, violently or explosively with many organic and inorganic chemicals, such as strong acids, nitroaromatic, nitroparaffin and organohalogen compounds, glycols and organic peroxides. Reacts violently with water generating significant heat and dangerously spattering corrosive sodium hydroxide. Violently polymerizes acetaldehyde, acrolein or acrylonitrile. Produces flammable and explosive hydrogen gas if it reacts with sodium tetrahydroborate or certain metals such as aluminum, tin, or zinc. Can form spontaneously flammable chemicals upon contact with 1,2- dichloroethylene, trichloroethylene or tetrachloroethane. Can produce carbon monoxide upon contact with solutions of sugars, such as fructose, lactose and maltose.

Corrosivity to Metals: Corrosive to aluminum, tin, zinc, copper, and most alloys in which they are present including brass and bronze. Corrosive to steel at elevated temperatures above 40°C(104ºF).

Stability and Reactivity Comments: Slowly attacks glass at room temperature.

Hazardous Polymerization: Will not occur. However, it can induce hazardous polymerization of acetaldehyde, acrolein, and acrylonitrile.

SECTION 11 – TOXICOLOGICAL INFORMATION

For more toxicological information, refer to Section 3.

TOXICOLOGICAL DATA:

Toxicological Data: Sodium hydroxide

Toxicity data: LDLo - Lowest published lethal dose oral rabbit 500 mg /kg ;
LD$_{50}$ intraperitoneal mouse 40 mg/kg

Irritation data: Standard Draize Tests: 500 mg/24 hour(s) skin-rabbit severe;
400 µg eyes-rabbit mild; 1 percent eyes-rabbit severe;

Mutagenicity: There is no evidence of mutagenic potential.

Reproductive Effects: No information is available.

Teratogenicity and Fetotoxicity: No information is available.

Synergistic Materials: No information is available.

Skin and Respiratory Sensitization: No information is available.

Irritancy: Strong eye and skin irritant.

SECTION 12 – ECOLOGICAL INFORMATION

Ecotoxicological Information:
LC$_{100}$ Cyprinus Carpio 180 ppm/24 hr @ 25°C (77°F)
TLm mosquito fish 125 ppm/96 hr (fresh water);
TLm Bluegill 99 mg/L/48 hr (tap water)

Persistence and Degradation: Degrades readily by reacting with natural carbon dioxide in the air. Does not bioaccumulate.

SECTION 13 – DISPOSAL CONSIDERATIONS

Review federal, state and local government requirements prior to disposal.

Do not dispose of waste with normal garbage, or to sewer systems.

Whatever cannot be saved for recovery or recycling, including containers, should be managed in an appropriate and approved waste disposal facility. Processing, use or contamination of this product may change the waste management options.

RCRA: Test waste material for corrosivity, D002, prior to disposal.

SECTION 14 – TRANSPORT INFORMATION

	TDG	DOT
Shipping Name	SODIUM HYDROXIDE, SOLUTION	Sodium hydroxide, solution
Hazard Class/Division	8	8
Identification No.	UN1824	UN1824
Packing Group:	II	II
Reportable Quantity	Not Applicable	RQ: 1000 lbs. (454 kg)
ERAP	NONE	Not Applicable

Δ **IATA/ICAO Shipping Description:** UN1824, Sodium hydroxide solution, Class 8, PG II is accepted for air transport.

Δ **For Chemical Emergencies in Transportation Requiring Activation of Olin 24 Hour Emergency Response Plan Call:**
U.S. 1-800-424-9300 – Chemtrec
Canada 1-800-567-7455

SECTION 15 – REGULATORY INFORMATION

Δ **CANADIAN INFORMATION:**

This product has been classified in accordance with the hazard criteria of the CPR (Controlled Products Regulations) and this MSDS (Material Safety Data Sheet) contains all the information required by the CPR.

Controlled Products Regulations (WHMIS) Classification:
E: Corrosive Material

CEPA / Canadian Domestic Substances List (DSL): Y

WHMIS Ingredient Disclosure List: Meets criteria for disclosure at 1% or greater.

Δ **USA INFORMATION:**

OSHA Classification: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200)

SARA Regulations sections 313 and 40 CFR 372: N

SARA Hazard Categories, SARA SECTIONS 311/312 (40 CFR 370.2):
ACUTE: Y
CHRONIC: N
FIRE: N
REACTIVE: Y
SUDDEN RELEASE: N
OSHA PROCESS SAFETY (29 CFR 1910.119): N

CERCLA SECTION 103 (40 CFR 302.4): Y

Reportable Quantity (RQ) under CERCLA: 1000 lbs. (454 kg)

TSCA Inventory Status: Y

This product does not contain nor is it manufactured with ozone depleting substances.

Δ **EUROPEAN ECONOMIC COMMUNITY (EEC) INFORMATION:**

EINECS Number: 215-185-5

CALIFORNIA PROP 65 COMPONENTS:
This product is not listed, but it may contain elements known to the State of California to cause cancer or reproductive toxicity as listed under Proposition 65 State Drinking Water and Toxic Enforcement Act. For additional information, contact Olin Technical Services (800-299-6546)

SECTION 16 – OTHER INFORMATION

Δ **The information contained herein is offered only as a guide to the handling of this specific material and has been prepared in good faith by technically knowledgeable personnel. It is not intended to be all-inclusive and the manner and conditions of use and handling may involve other and additional considerations. No warranty of any kind is given or implied and Olin will not be liable for any damages, losses, injuries or consequential damages that may result from the use of or reliance on any information contained herein. This Material Safety Data Sheet is valid for three years.**

Revision Indicators:
Δ In the left margin indicates a revision or addition of information since the previous issue.

National Fire Protection Association (NFPA) Rating
Hazardous Materials Identification System (HMIS) Rating

Δ

	NFPA	HMIS
HEALTH	3	3
FIRE	0	0
REACTIVITY / INSTABILITY	1	1
SPECIAL HAZARDS	N/Ap	N/Ap

4 = Extreme/Severe
3 = High/Serious
2 = Moderate
1 = Slight
0 = Minimum
~~W~~ = Water Reactive
OX = Oxidizer
* = Chronic health hazard

Δ **REFERENCES:**

1. Chemlist, STN Database, Chemical Abstract Service, 1999
2. "CHEMINFO", CCOHS, Canadian Centre for Occupational Health and Safety, Hamilton, Ontario, Canada, (2008).
3. DOSE, Royal Society of Chemistry, Aug 27, 1999.
4. HSDB- Hazardous Substances Data Bank, CCOHS, 2008.
5. RTECS-Registry of Toxic Effects of Chemical Substances, On-line search, Canadian Centre for Occupational Health and Safety RTECS database, Doris V. Sweet, Ed., National Institute for Occupational Safety and Health, U.S. Dept. of Health and Human Services, Cincinnati, Entry Update/ August 2007.
6. "2008 Threshold Limit Values and Biological Exposure Indices", American Conference of Government Industrial Hygienists, 2008.
7. Merck, 11th Edition, 1989

Δ **LEGEND:**

ACGIH	- American Conference of Governmental Industrial Hygienists
AFFF	- Aqueous Film Forming Foam
AIHA	- American Industrial Hygiene Association
CAS #	- Chemical Abstracts Service Registry Number
CERCLA	- Comprehensive Environmental Response, Compensation, and Liability Act
CFR	- Code of Federal Regulations
DOT	- Department of Transportation
EINECS	- European Inventory of Existing Chemical Substances
EPA	- Environmental Protection Agency
ERAP	- Emergency Response Assistance Plan
IATA	- International Air Transportation Association
ICAO	- International Civil Aviation Organization
FRP	- Fiberglass Reinforced Plastic
HMIS	- Hazardous Materials Identification System
IARC	- International Agency for Research on Cancer
IDLH	- Immediately Dangerous to Life and Health
LC50	- The concentration of material in air expected to kill 50% of a group of test animals
LD_{50}	- Lethal Dose expected to kill 50% of a group of test animals
MSHA	- Mine Safety and Health Administration
N/Ap	- Not Applicable
N/Av	- Not Available
NFPA	- National Fire Protection Association
NIOSH	- National Institute for Occupational Safety and Health
NTP	- National Toxicology Program
OSHA	- Occupational Safety & Health Administration
PEL	- Permissible Exposure Limit
PVC	- Polyvinyl chloride
RCRA	- Resource Conservation and Recovery Act
SARA	- Superfund Amendments and Reauthorization Act of the U.S. EPA
STEL	- Short Term Exposure Limit
TDG	- Transportation of Dangerous Goods Act/Regulations
TLV	- Threshold Limit Value
TSCA	- Toxic Substances Control Act
TWA	- Time Weighted Average
WEEL	- Workplace Environmental Exposure Level
WHMIS	- Workplace Hazardous Materials Identification System