



SUMMARY

RemOx® SR+ ISCO reagent and Persulfate SR ISCO reagent cylinders are an innovative, long-term, solution for passively treating contaminants *in situ*. RemOx SR+ cylinders consist of ~38% solid potassium permanganate and ~38% solid sodium persulfate homogeneously dispersed within a solid paraffin wax matrix. The wax matrix serves to slow down the instant dissolution of permanganate/persulfate and allows for slow sustained release of oxidants into groundwater over several years. RemOx SR+ is manufactured with RemOx® S ISCO reagent, which is the solid form of potassium permanganate that has been used to remediate hundreds of contaminated sites worldwide. Persulfate SR ISCO reagent is ~73% sodium persulfate in a solid paraffin wax matrix.

RemOx SR+ and Persulfate SR applications may vary from direct push to in-well applications. These cylinders can be used for source zone treatment or deployed as a reactive zone or barrier wall to prevent off-site contaminant migration. RemOx SR+ can be used in combination with RemOx® L ISCO reagent liquid injection to ensure long-term presence of permanganate and help mitigate contaminant desorption and back-diffusion. This technology is ideal for Brownfields, dry cleaners and active industrial and military sites where passive *in situ* treatment occurs without aboveground equipment or infrastructure. Another advantage of RemOx SR+ and Persulfate SR is the ability to apply the technology in an iterative approach to treat target locations and effectively manage project costs.

HEALTH AND SAFETY

RemOx SR+ and Persulfate SR are stable under normal conditions. Do not expose to sparks, heat, open flames, or hot surfaces. It is important that smoking is not allowed in proximity to these products. Do not cut with any cutting tool which could produce friction (i.e. hand saws, circular saws, reciprocal saws, etc.) as it may cause ignition of the material. In case of fire, use large amounts of water to extinguish.

Store RemOx SR+ and Persulfate SR in a cool, dry place in closed containers and out of direct sunlight. Caution should be taken when working in high heat environments, as product shape may become malformed.

RemOx SR+ and Persulfate SR are oxidizers and should be handled accordingly. All field personnel should be trained and have reviewed the Safety Data Sheet (SDS) prior to working with RemOx SR+ or Persulfate SR. Wear appropriate gloves, clothing, eye protection, and face protection. Be cautious of underground and overhead utilities.

The paraffin wax is non-toxic and biodegradable and can remain in the subsurface (3rd party verified).

PRODUCT FORMS

All sustained release cylinders are manufactured as 18 inches in length and available in 2.5 inch diameter (suitable for use with standard DPT rod sizes).

APPLICATION GUIDANCE

For use in existing wells:

Carus offers cylinder holders that can be used in conjunction with RemOx SR+ and Persulfate SR. Cylinder holders are constructed of PVC. Multiple cylinders and cylinder holders can be emplaced above one another to treat the entire screened interval. Alternatively, each plastic holder can be individually cabled to the monitoring well cover. Cylinder holders can be anchored to above-ground infrastructure and allow for easy recovery of the cylinders and quick recharge, if needed.



APPLICATION GUIDANCE

For use with direct push technology (DPT):

RemOx[®] SR+ ISCO and Persulfate SR ISCO reagents can be simply emplaced into the subsurface using standard DPT rod sizes (3.25 inch) used to advance the deployment borehole. Cylinder emplacement will be accomplished by first advancing direct-push rods to depth. The deepest cylinder will then be placed in the bottom of the borehole through the direct-push rods. This cylinder stacking process can be repeated as many times as needed. The borehole should be backfilled to the ground surface with hydrated bentonite.

IDEAL CONFIGURATIONS

In order to maximize distribution of the oxidant(s), the following recommendations can be made:

- Cylinder locations should be closely spaced (3 to 5 feet) in each row
- Multiple rows will maximize the distribution of permanganate
- RemOx SR+ application in conjunction with the injection of RemOx[®] L ISCO reagent can enhance the performance at sites with high natural oxidant demand (NOD) or potential for back diffusion.
- In well deployment (figure 1)
- Reactive barrier/zone (figure 2)
- Convergent divergent flow: “mini” funnel and gate (figure 3)
 - 2.5” oxidant cylinder
 - 4” well
 - 18” borehole backfilled with sand
 - Create zone of convergence/divergence from contrast in hydraulic conductivity
 - Addresses low transverse dispersion issue
- Funnel and gate (figure 4)

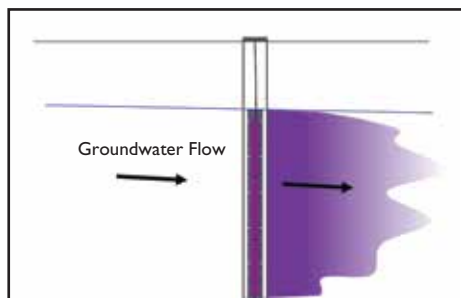


Figure 1: In Well Cylinder Deployment

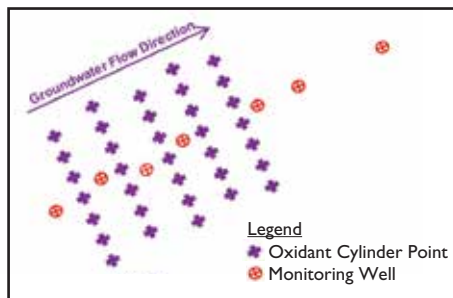


Figure 2: Reactive Barrier/Zone

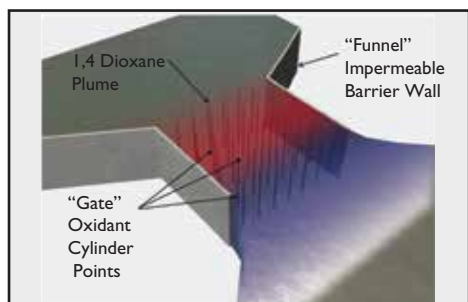


Figure 4: Funnel and Gate
(Image Courtesy of CDM Smith)

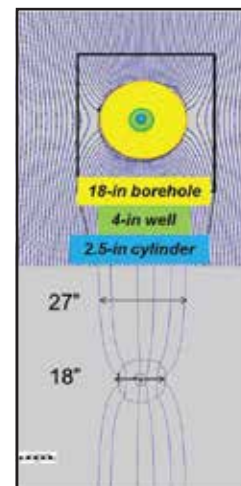


Figure 3: Convergent Divergent Flow-Focusing:
“Mini” Funnel and Gate
(Image Courtesy of CDM Smith)