Table A-15.A. In situ chemical oxidation

Technology	In situ chemical oxidation	ISCO involves injecting an oxidant to react with and destroy organic compounds. Treatment of LNAPL sites using ISCO may focus on treatment of the dissolved plume, soils, or LNAPL; however, oxidation reactions occur in the dissolved phase. The oxidant must be matched to the site conditions and the project objectives. Effective oxidant delivery and contact with the target treatment media, as well as delivery of an adequately aggressive and stoichiometrically correct oxidant dose, are requisites for effective ISCO application. Increased groundwater concentrations of LNAPL constituents after initial ISCO application is common.	
Remediation process	Physical mass recovery	No	N/A
	Phase change	Yes	Mass destruction in the dissolved-phase drives mass transfer from the LNAPL phase.
	In situ destruction	Yes	Under appropriate conditions, ISCO acts to break the hydrocarbon molecular bonds, producing CO2 and water as by-products.
	Stabilization/ binding	No	N/A
Objective applicability	LNAPL saturation	No	N/A
		Example performance metrics	N/A
	LNAPL composition	Yes	Abate accumulation of unacceptable constituent concentrations in soil vapor and/or dissolved phase from an LNAPL source.
		Example performance metrics	LNAPL composition change; soil VOC concentrations to below regulatory standard; soil vapor plume concentrations to below regulatory standard.
Applicable LNAPL type	Applicability depends on the chemical oxidation susceptibility of the chemicals in the LNAPL or of the LNAPL constituents in either soil or groundwater.		
Geologic factors	Unsaturated zone	Geologic factors for ISCO application in the unsaturated zone are dominated by oxidant transport and delivery requirements. It is very difficult to deliver aqueous-phase oxidants to the unsaturated zone due to the limitations of unsaturated flow. Ozone, a gaseous oxidant, is amenable to delivery in the unsaturated zone, although its high rate of reaction is a transport limitation which often dictates relatively close injection-well spacing. More homogeneity and higher permeability result in more effective treatment.	
	Saturated zone	Low permeability and heterogeneity are challenging for amendment delivery and reduce efficiency and effectiveness. Delivery of gaseous oxidants to the saturated zone involves gas sparging, which is strongly affected by geologic heterogeneity and grain size and permeability distributions. High natural oxidant demand exerted by the native aquifer matrix, including both reduced minerals and soil organics, reduces ISCO efficiency.	