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ESTCP

ENVIRO.WIKI

Tech Transfer in the 21st Century

Bilgen Yuncu, PhD, PE, Allison Stenger
and Robert C Borden, PE, PhD
Draper Aden Associates

Eleventh International Conference on Remediation of Chlorinated and Recalcitrant Compounds,
Palm Springs, California - April 8-12, 2018

Problem

Extensive research that is not easily accessible.

Internet makes it easy to find LOTS of information

- Massive volume of information
- Lots of outdated information
- Limited Integration
- It just takes too much time!

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Search Engines

- Priority given to # links and # “clicks”
- No quality assurance / peer review
- Time consuming to find most recent/relevant work

Brossard, D. & D. A. Scheufele, 2013. Science, New Media, and the Public. Science Magazine.

Science and Engineering Indicators, 2012. National Science Board

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Wikipedia

Fantastic Resource

- Well written, concise articles
- more than 47,000,000 articles in 299 languages
- 18 billion page views
- Continually updated and improved

Limitations

- Susceptible to systemic bias
- Does not require any credentials for editing
- Limited information on many current technologies

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Our Solution-ENVIRO Wiki

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ENVIRO Wiki

Short ‘encyclopedia’ articles on environmental topics

- Easy to understand
- Lead you to the best research on the topic
- Library of original documents
- Lots of links for more detailed info.

http://www.ENVIRO.wiki

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Major Sections

- Attenuation & Transport Processes
- Characterization, Assessment & Monitoring
- Contaminants
- Energetic Materials
- Monitored Natural Attenuation
- Regulatory Issues & Site Management
- Remediation Technologies

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Example Articles

- Dispersion and Diffusion
- Molecular Biological Tools
- Chlorinated Solvents
- Energetics Deposition
- Natural Source Zone Depletion
- Plume Response Modeling
- Anaerobic Bioremediation

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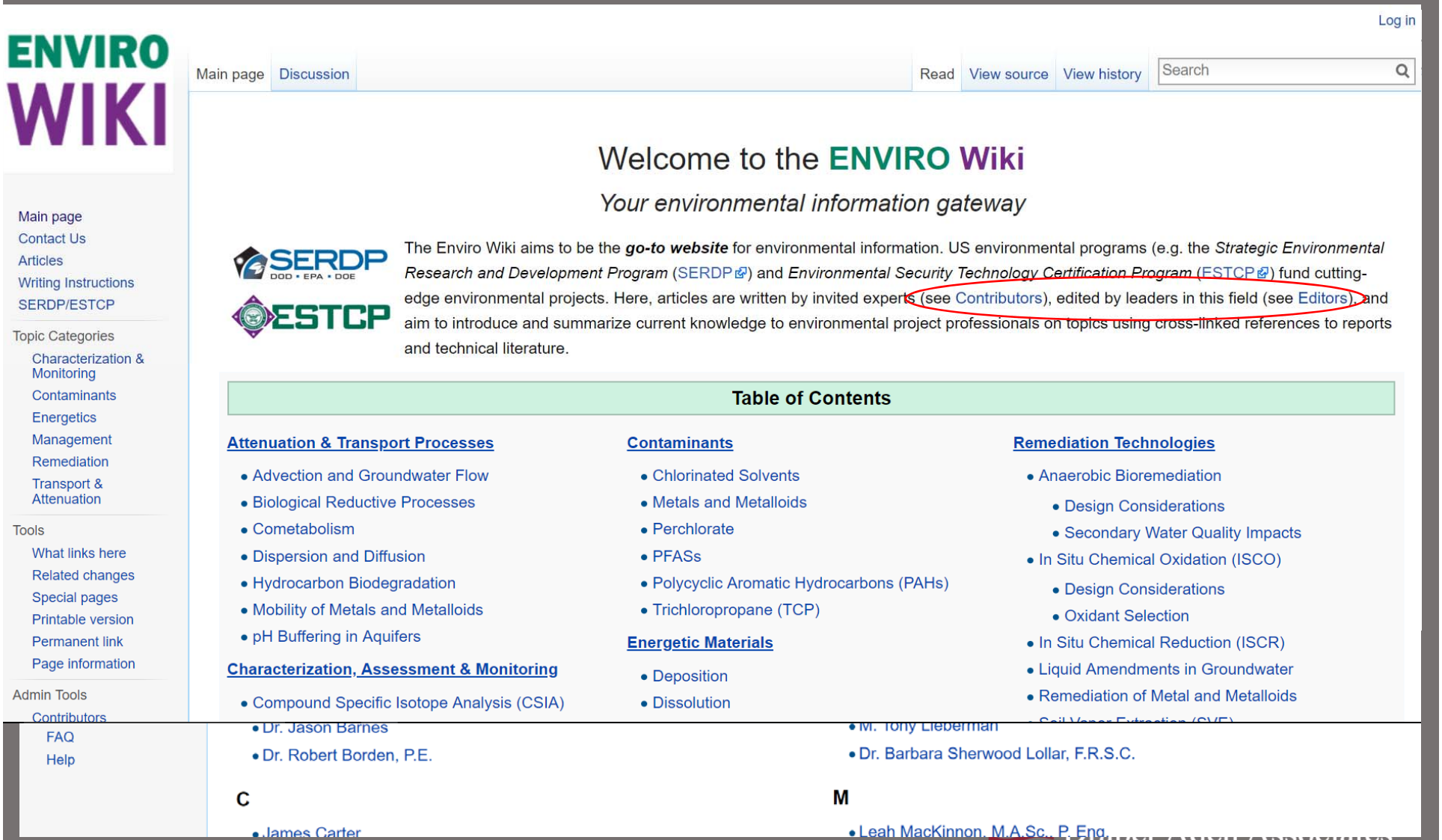

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Welcome to the ENVIRO Wiki

Your environmental information gateway

SERDP DOD • EPA • DOE

ESTCP

The Enviro Wiki aims to be the ***go-to website*** for environmental information. US environmental programs (e.g. the *Strategic Environmental Research and Development Program* (SERDP) and *Environmental Security Technology Certification Program* (ESTCP) fund cutting-edge environmental projects. Here, articles are written by invited experts (see Contributors), edited by leaders in this field (see Editors), and aim to introduce and summarize current knowledge to environmental project professionals on topics using cross-linked references to reports and technical literature.

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- Dispersion and Diffusion
- Hydrocarbon Biodegradation
- Mobility of Metals and Metalloids
- pH Buffering in Aquifers

Characterization, Assessment & Monitoring
- Compound Specific Isotope Analysis (CSIA)

Contaminants
- Chlorinated Solvents
- Metals and Metalloids
- Perchlorate
- PFASs
- Polycyclic Aromatic Hydrocarbons (PAHs)
- Trichloropropane (TCP)

Energetic Materials
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Remediation Technologies
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  - Design Considerations
  - Secondary Water Quality Impacts
- In Situ Chemical Oxidation (ISCO)
  - Design Considerations
  - Oxidant Selection
- In Situ Chemical Reduction (ISCR)
- Liquid Amendments in Groundwater
- Remediation of Metal and Metalloids

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Characterization, Assessment & Monitoring

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  - DP Sampling
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  - LTM Data Variability
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Contaminants

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- Metals and Metalloids
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- Trichloropropane (TCP)

Energetic Materials

- Deposition
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- Sorption
- Toxicology
- TREECS™

Monitored Natural Attenuation (MNA)

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- MNA of Petroleum Hydrocarbons
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In Situ Chemical Oxidation - ISCO

Chemical Oxidation is an in situ remediation technology that can be applied to groundwater or soils and many different contaminants. It is a chemical technology where strong oxidants are injected or mechanically mixed into the treatment zone to promote destructive abiotic degradation reactions. It is commonly used, applicable to many hydrogeologic settings, and relies on well-known technologies such as injection and mixing. Because of stoichiometry and mass balance limitations, it may be inefficient when applied to treat free-phase (i.e., free-product or non-aqueous phase liquid (NAPL)) zones.

Related Article(s):

- Oxidant Selection for ISCO
- ISCO Design Considerations
- Injection and Distribution of Liquid Amendments in Groundwater
- Monitored Natural Attenuation (MNA)

CONTRIBUTOR(S): Dr. Michelle Crimi

Key Resource(s):

- In Situ Chemical Oxidation for Groundwater Remediation Protocol (ESTCP ER-200623) [1]

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1 Introduction
2 Contaminant Treatability
3 Applicability of ISCO to Site Conditions
4 Tools
5 Advantages and Disadvantages
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Introduction

In situ chemical oxidation (ISCO) is a mature technology for remediation of contaminated groundwater, including both source zones and contaminant plumes. ISCO involves the introduction of chemical oxidants into the subsurface to react with contaminants to convert them into less harmful products. Commonly used oxidants include Fenton's reagent, ozone, potassium permanganate, and sodium persulfate.

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Extensive Links, Online Referencing & "See Also"

References

1. ^ [1.0] [1.1] Siegrist, R.L., 2010. In situ chemical oxidation for groundwater remediation - technology practices manual. ESTCP Project ER-0623. ER-200623
2. ^ Siegrist, R. L. Urynowicz, M.A., West, O.R., Crimi, M.L. and Lowe, K.S., 2001. Principles and practices of in situ chemical oxidation using permanganate. Columbus, OH: Battelle Press. ISBN-10: 1574771027. doi: 10.1016/S0304-3894(01)00355-7
3. ^ ITRC, 2005. Technical and Regulatory Guidance for In Situ Chemical Oxidation of Contaminated Soil and Groundwater. Council TITaR, editor. Report pdf
4. ^ Huling, S. G., and Pivetz, B. E., 2006. In-situ chemical oxidation (No. EPA/600/R-06/072). Environmental Protection Agency, Washington, DC. Office of Water. Report pdf
5. ^ Krembs, F.J., Siegrist, R.L., Crimi, M.L., Furrer, R.F. and Petri, B.G., 2010. ISCO for groundwater remediation: analysis of field applications and performance. Groundwater Monitoring & Remediation, 30(4), 42-53. doi: 10.1111/j.1745-6592.2010.01312.x
6. ^ [6.0] [6.1] [6.2] [6.3] [6.4] Siegrist, R.L., Crimi, M. and Simpkin, T.J. eds., 2011. In situ chemical oxidation for groundwater remediation (Vol. 3). Springer Science & Business Media. 678 pgs. ISBN: 978-1-4419-7825-7. doi: 10.1007/978-1-4419-7826-4
7. ^ [7.0] [7.1] McGuire, T., 2016. Development of an Expanded, High-Reliability Cost and Performance Database for In-Situ Remediation Technologies. ESTCP Project ER-201120. ER-201120
8. ^ ESTCP, 2009. Database for ISCO (DISCO). ER-0623. ER-0623
9. ^ Borden, R., Cha, K.Y., Simpkin, T. and Lieberman, M.T, 2010. Development of Design Tools for Planning Aqueous Amendment Injection Systems. Permanganate Design Tool. ESTCP Project ER-200626. ER-200626

See Also

- Improved Understanding of Fenton-Like Reactions for In Situ Remediation of Contaminated Groundwater Including Treatment of Sorbed Contaminants and Destruction of DNAPLs
- Improved Understanding of In Situ Chemical Oxidation (ISCO)
- Reaction and Transport Processes Controlling In Situ Chemical Oxidation of DNAPLs
- Control of Manganese Dioxide Particles Resulting from In Situ Chemical Oxidation Using Permanganate
- Enhanced Reactant-Contaminant Contact Through the Use of Persulfate In Situ Chemical Oxidation (ISCO)
- Semi-Passive Oxidation-Based Approaches for Control of Large, Dilute Groundwater Plumes of Chlorinated Ethylenes
- Impacts on Groundwater Quality Following the Application of ISCO: Understanding the Cause of and Designing Mitigation for Metals Mobilization
- CleanOX® In Situ Chemical Oxidation of Groundwater

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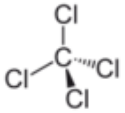
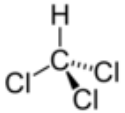
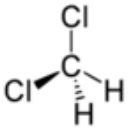
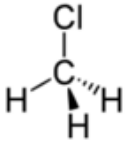
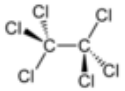
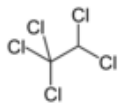
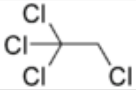
Table 1. Nomenclature, Structure, Chemical and Physical Properties of Most Widely Used Chlorinated Solvents[1]. [Collapse]

IUPAC Name	Common Name	Acronym	Molecular Formula	Chemical Structure	Formula Weight	Density (ρ)(g/mL)	Aqueous Solubility (mg/L)	Vapor Pressure (ρ^0) (kPa)	Henry's Law Constant[a]	Log K_{ow}	MCL[b] (µg/L)
Chlorinated Methanes											
tetrachloromethane	carbon tetrachloride	CT	CCl_4		153.8	1.59	800	20.5	28.9	2.64	0.005
trichloromethane	chloroform	CF	$CHCl_3$		119.4	1.49	8,200	26.2	3.8	1.97	0.080[c]
dichloromethane	methylene chloride	DCM	CH_2Cl_2		84.9	1.33	13,200	55.3	1.7	1.25	0.005
chloromethane	methyl chloride	CM	CH_3Cl		50.5	0.92	5,235	570	9.6	0.91	NR[d]
Chlorinated Ethanes											
hexachloroethane	perchloroethane	HCA	C_2Cl_6		236.7	2.09	50	0.05[e]	-	3.93	NR
pentachloroethane	-	PCA	C_2HCl_5		202.3	1.68	500	0.6	2.5	2.89	NR
1,1,1,2-tetrachloroethane	-	1,1,1,2-TeCA	$C_2H_2Cl_4$		167.9	1.54	1,100	1.6	2.4	-	NR

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permeability, which dictates the spatial distribution of air flow, can affect the distribution of smoldering full scale applications, and challenges associated with *in situ* application are described elsewhere[1][3]

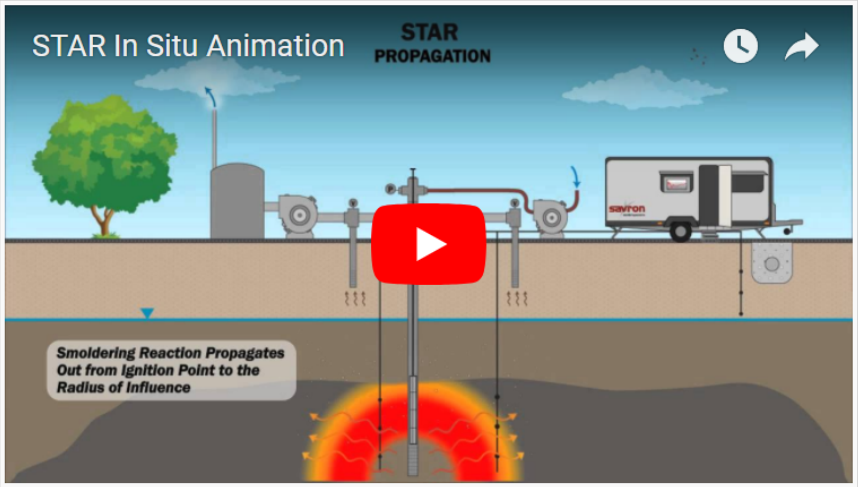


Figure 5. Animation of the stages of an *in situ* smoldering remediation treatment below the water table including typical equipment employed.

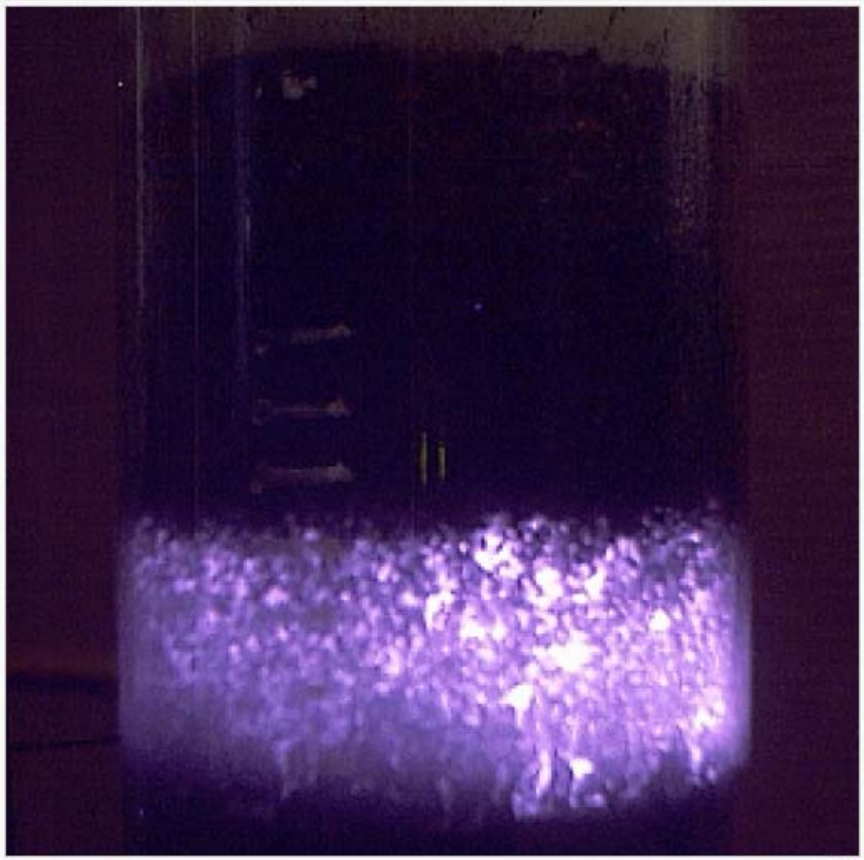
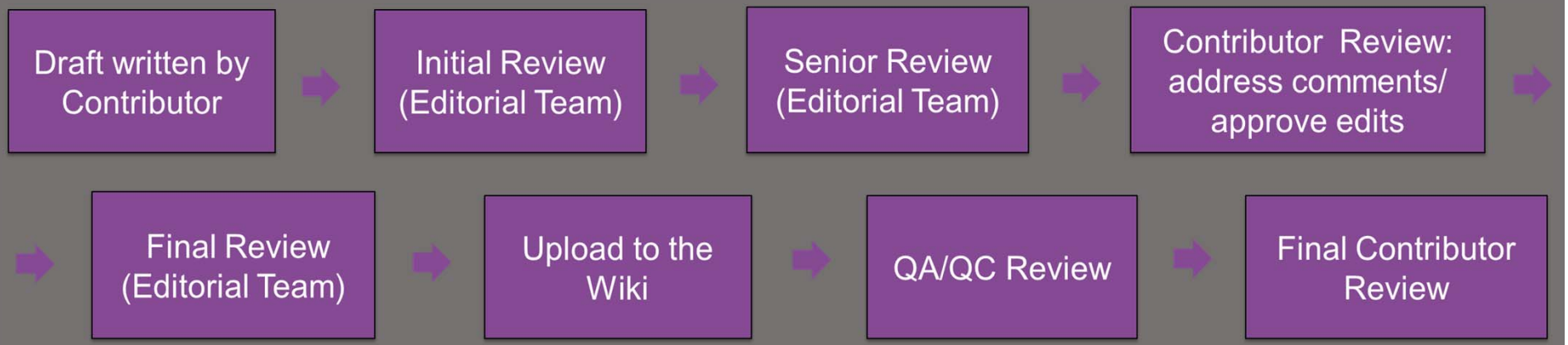


Figure 3. Webcam video of a self-sustaining smoldering reaction traveling upwards in a 30 cm tall transparent quartz column containing coal tar contaminated soil (accelerated 50 times).

The Creation

Prepared by internationally recognized experts

Extensive peer review



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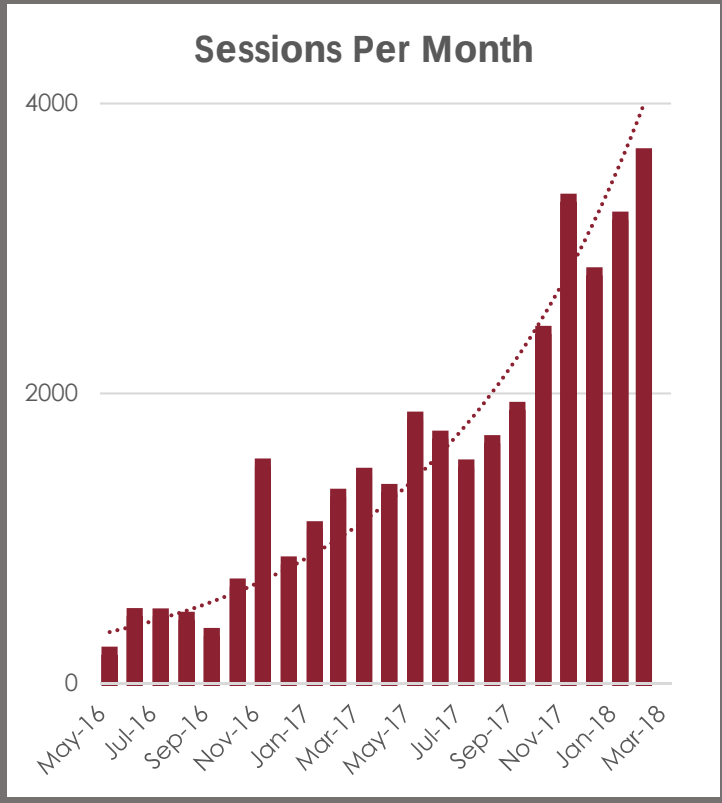
Outreach

Google analytics

- Totals since May 2016
  - > 81,000 page views
  - > 34,000 sessions
  - > 29,000 page views (36%) with durations lasting >10min
  - Avg. 5min per session for returning users



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ER Wiki

- 60 Articles
- 121 pages (articles + miscellaneous pages)
- References
  - 747 external links
  - 383 internal documents / pdfs

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Lessons Learned

Continuous Improvement

- Highlight recent research
- Provide alternative points of view

Difficult to find authors for

- 'Older' topics (e.g. pump and treat)
- Edit / update existing articles

Videos

- Most available videos too long / do not fit with wiki format

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Wiki 2

- Wiki 1 → Environmental Restoration Program Area
- Wiki 2 → Other Program Areas
- Additional 60 articles
- Updates to existing articles
- Graphics & videos
- Editorial policy – the future!

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- Contact form on the website
- Suggestions for new topics, website improvements and general impressions are all welcome
- Additional 'hard to find' documents

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