

STATE OF CALIFORNIA
REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL COAST REGION

STAFF REPORT FOR REGULAR MEETING OF JULY 11, 2008
Prepared on June 12, 2008

ITEM NUMBER: 8

SUBJECT: Olin Groundwater Cleanup, Santa Clara County-
Status Report

DISCUSSION:

Note: *New information is shown in italics.*

General Perchlorate information:

Background

Perchlorate is both a naturally occurring and man-made chemical, although it is rarely found naturally in the United States. One-third of all perchlorate used in the United States is used in California and 90% of California's perchlorate use is related to the aerospace industry. There are three major sources of perchlorate in the United States: ammonium perchlorate is used as an oxidizer in solid rocket propellants, sodium perchlorate is used in slurry explosives, and potassium perchlorate is used in road flares and air bag inflation systems. Wastes from the manufacture and improper disposal of perchlorate-containing chemicals are increasingly being discovered in soil and water.

Health Effects

Perchlorate interferes with the natural function of the thyroid gland by inhibiting the uptake of iodide. Because iodide is an essential component of thyroid hormones, perchlorate disrupts how the thyroid functions. Such an effect decreases production of thyroid hormones, which are needed for prenatal and postnatal growth and development, as well as for normal body metabolism. Potassium perchlorate was used until recently to treat hyperthyroidism related to Graves disease, and is still used diagnostically to test thyroid hormone production in some clinical settings.

Regulatory Standards

Perchlorate is a regulated drinking water contaminant in California, with a maximum contaminant level (MCL) of 6 micrograms per liter ($\mu\text{g/L}$), effective October 18, 2007. Currently there is no federal drinking water MCL for perchlorate. The U.S. Environmental Protection Agency (USEPA) is in the process of studying the occurrence and health effects of perchlorate.

Treatment Methods

Treatment of perchlorate contamination in water is complicated because the perchlorate anion does not respond to typical water treatment techniques due to its fundamental physical and chemical nature. The perchlorate ion tetrahedron itself is structured such that the four oxygen atoms surround the central chlorine atom, effectively blocking reductants from directly attacking the chlorine atom. Although perchlorate is thermodynamically a strong oxidizing agent, it is a

kinetically sluggish species, making its reduction generally very slow and rendering common reductants ineffective. Perchlorate can persist in the environment for many decades under typical groundwater and surface water conditions because of its resistance to react with other available constituents.

Perchlorate treatment technologies may be generally classified into categories of destruction or removal technologies. Destructive processes include biological reduction, chemical reduction, and electrochemical reduction. Physical removal processes include anion exchange, membrane filtration (including reverse osmosis and nanofiltration), and electrodialysis, which all require subsequent disposal of removed perchlorate. The optimum treatment technology for a given perchlorate occurrence may depend on several factors, including perchlorate concentration, the presence and concentration of co-contaminants, other water quality parameters and geochemical parameters. The presence of indigenous perchlorate-reducing microbes and substances inhibitory to their activity will also influence perchlorate treatment technology effectiveness. For in-situ treatment of perchlorate contamination, variables related to the site hydrogeologic setting, such as depth to and distribution of contaminants, soil permeability, groundwater flow velocity, etc. are also additionally important.

Olin Corporation Facility, 425 Tennant Avenue, Morgan Hill, Santa Clara County

Project Manager: Hector Hernandez

Technical Support: Diane Kukol

Effective immediately, Ms. Diane Kukol has joined the perchlorate cleanup team and Ms. Kukol will provide technical support on the Olin cleanup case. Diane has a B.S. in Geology and an M.S. in Hydrogeology. Diane has worked on various groundwater cleanup projects at the Central Coast Water Board since 1992.

Background

The former Olin Corporation site is a 13-acre parcel located in southern Morgan Hill. Olin and Standard Fusee used potassium perchlorate in the manufacture of flares from 1956 to 1995. Olin manufactured signal flares at the facility for about 32 years, from 1956 to 1988. Standard Fusee leased the site and manufactured signal flares for seven years from 1988 to 1995. A potential buyer first detected perchlorate at the site in August 2000 during a due diligence investigation. Olin made initial contact with Central Coast Water Board staff regarding the perchlorate contamination in February 2001. Perchlorate contamination at the site may have occurred primarily from an unlined evaporation pond that received wastes from the cleaning of the ignition material mixing bowls, on-site incineration of cardboard flare coatings with residues on them, and accidental spills. The Central Coast Water Board never formally regulated waste disposal practices while the facility operated, but facility records document inspections by Water Board staff.

Groundwater in the area is typically in alluvial sediments, at depths ranging from seven to about 570 feet below ground surface. The alluvial deposits are composed of heterogeneous layers of clay, silt, sand, and gravel. Interconnected multiple aquifers exist within the area. Groundwater underneath the site is generally unconfined, although there are identified confined zones within the sub-basin to the southeast of the property. The groundwater flow direction is predominantly to the south-southeast with occasional variation to the south and south-southwest. Olin has included a detailed description of geology and hydrogeologic conditions within the Llagas Subbasin in their January 31, 2007, *Llagas Subbasin Characterization – 2006*, Santa Clara County Olin/Standard Fusee, Morgan Hill, California (2006 Characterization Report).

The former Olin facility is located in the Llagas Subbasin of the Gilroy-Hollister Groundwater Basin in South Santa Clara County. The Llagas Subbasin is a northwest to southeast trending alluvial-filled structural depression that is, in part, the southern extension of the north bounding Coyote Groundwater Subbasin. The Llagas Subbasin's northern boundary consists of a groundwater divide that is believed to coincide with the Coyote Creek alluvial fan topographic high as it emerges from the eastern foothills. The Llagas Subbasin is further bounded on the west by the Santa Cruz Mountains/Gavilan Range and on the east by the Diablo Range, and merges to the south with the Gilroy-Hollister Groundwater Subbasin.

Residents, agricultural operations, businesses, and cities surrounding and downgradient of the former Olin facility rely solely on groundwater for domestic, agricultural, and industrial supply purposes. The known perchlorate plume area extends for approximately ten miles downgradient. Historically, approximately 800 offsite wells have had perchlorate detections.

Bottled Water Service Terminations

Private domestic supply well users in the Morgan Hill, San Martin, and Gilroy areas depend on well water as their main drinking water source. Olin continues to provide bottled drinking water to well owners and tenants whose wells have perchlorate concentrations greater than 6.0 µg/L. Olin's providing of replacement water is in accordance with the Central Coast Water Board Cleanup or Abatement Order No. R3-2004-0101, as revised by the State Water Resources Control Board in its Order WQ 2005-0007 (State Water Board Order) and Central Coast Water Board staff's letter dated October 6, 2006. The October 6, 2006 letter provides comments and clarifies all replacement water requirements (e.g., bottled water) and post-bottled water termination monitoring.

Central Coast Water Board staff continues to take a conservative approach addressing all issues related to bottled water service termination and monitoring requirements after Olin terminates bottled water service. *To date, the Central Coast Water Board's Executive Officer concurred with Olin's request to terminate bottled water service for 581 wells (one well fitted with an ion exchange [IX] system) in accordance with State Water Board Order requirements. However, Central Coast Water Board has not always concurred with Olin's request to terminate replacement water. In a letter dated July 19, 2006, Central Coast Water Board staff rejected Olin's request to terminate replacement water for 40 well users. Central Coast Water Board proceeded by issuing an August 2, 2006 Notice of Violation (NOV) letter that required Olin to supply replacement water to the 40 well users. Since July 2006, Olin has complied with all of the criteria outlined in the State Water Board Order to terminate bottled water.*

Since July 2006, Olin has reinstated bottled water service to users of 61 wells (out of the 581) because perchlorate concentrations greater than 6 µg/L were detected through post-bottled water termination monitoring. Olin is required to provide replacement water to well users for four quarters after perchlorate is detected greater than 6 µg/L. Central Coast Water Board staff will continue to review and evaluate all data submitted by Olin that is associated with bottled water terminations and post-bottled water termination monitoring.

Presently, Olin provides bottled drinking water to users of 108 wells that do not meet State Water Board criteria for terminating bottled water service. A total of 163 households are associated with these 108 wells. Therefore, perchlorate concentrations were greater than 6 µg/L at some time during the last four quarters in these 108 wells. Out of the 108 wells receiving replacement water, 35 domestic supply wells sampled during the first quarter of 2008, contained perchlorate concentrations above 6.0 µg/L.

Ion Exchange (IX) System Installations

Olin continues to operate and maintain IX systems on 12 private domestic supply wells; the systems continue to remove perchlorate as designed. In accordance with the State Water Board Order, Olin removed one domestic IX systems from service as replacement water and one IX system is off-line because the property is vacant. Olin began IX system installation at wells exceeding 10 µg/L, then at wells with concentrations between 8.0-9.9 µg/L. Presently, Olin has installed IX systems on all domestic supply wells with a perchlorate concentration above 7.9 µg/L that are actively used as potable water sources, as required by the Central Coast Water Board's most recent Cleanup Order. Installation of an IX system remains on hold at one well. Olin continues to evaluate the need to install IX systems on candidate wells that have had greater than 6.0 µg/L perchlorate detections during the past four quarters.

Olin will continue providing bottled water to IX wells pending Department of Public Health (DPH) acceptance of the domestic IX systems. In January 2007, Olin submitted its IX system pilot test protocol (Demonstration Protocol) to DPH and provided an update in May 2007. Olin submitted a second Demonstration Protocol report on November 15, 2007. All of the demonstration sites appear to be eliminating perchlorate from groundwater, as expected. MACTEC, on behalf of Olin, also conducts monthly inspections of the IX systems. DPH review and approval on the first and second reports remain pending.

Central Coast Water Board staff is coordinating with Olin and DPH staff to assist in expediting DHP's evaluation process and helping obtain the necessary domestic IX system approvals.

Cleanup Order No. R3-2007-0077

At the December 7, 2007 Water Board hearing, the Central Coast Water Board authorized the Executive Officer to issue Cleanup and Abatement Order No. R3-2007-0077 (Cleanup Order No. R3-2007-0077). Cleanup Order No. R3-2007-0077 rescinds Cleanup Order No. R3-2005-0014, as amended by Cleanup Order No. R3-2006-0112, but does not remove any requirements of the prior Order.

Cleanup Order No. R3-2007-0077 outlines Olin's groundwater cleanup requirements, including the groundwater cleanup approach, strategy, and schedule necessary to achieve compliance with groundwater cleanup requirements.

- **Petition** - The City of Morgan Hill (City) filed a petition with the State Water Board requesting review of Cleanup Order No. R3-2007-0077, issued to Olin Corporation. In addition, the City requested a) approval to submit supplemental evidence to the State Water Board, and b) a hearing on the supplemental evidence. The State Water Board received the City's petition on January 7, 2008.

On January 23, 2008, the Central Coast Water Board staff sent a letter to the State Water Board to object to the City's requests and to urge the State Water Board to deny both requests.

On March 4, 2008, the State Water Board agreed to review the City's petition and requested the Central Coast Water Board provide a response to the petition and the administrative record. On April 3, 2008, the Central Coast Water Board submitted its response to the State Water Board regarding the City's petition.

- **Status of Investigation and Cleanup Activities** - In accordance with Cleanup Order No. R3-2007-0077, Olin has achieved compliance with the following tasks and report submittals:

By December 31, 2007, Olin shall complete installation and hydraulic testing of the Priority Zone A intermediate zone groundwater extraction well: Olin completed installation and hydraulic testing of an intermediate zone groundwater extraction well and demonstrated that the extraction well will achieve complete hydraulic capture of Priority Zone A and Priority Zone B upgradient from the extraction well.

By March 28, 2008, Olin shall complete installation and hydraulic testing of the deep aquifer groundwater extraction well: On March 5, 2008, Central Coast Water issued a letter concurring with a January 14, 2008 letter from Olin requesting additional time to complete characterization activities and design hydraulic containment in the deep aquifer. Central Coast Water Board concurred with Olin's extension request based on our understanding that characterization within the deep aquifer has taken longer than originally planned and has required additional, unanticipated monitoring wells. Our March 5, 2008 letter required Olin to include a deep aquifer implementation schedule for the installation and testing of a deep aquifer groundwater extraction well(s) in the Feasibility Study Addendum due on April 15, 2008.

April 15, 2008, Area I Plume Migration Control Feasibility Study Addendum (Feasibility Study Addendum): Central Coast Water Board staff completed review and accepted Olin's Feasibility Study Addendum as complete and in compliance with Cleanup Order No. R3-2007-2007. According to the FS Addendum, Olin confirmed that its proposed intermediate aquifer groundwater containment system would mirror the existing onsite shallow containment system. Olin will use extraction well IEW-1 to remove groundwater from the intermediate aquifer, and will transport extracted groundwater to the former Olin site via a pipeline. After the extracted water arrives at the site, Olin will treat it with the onsite IX system, and then recharge the treated water to the aquifer via injection wells. Olin anticipates complete capture of Priority Zones A and B upgradient of IEW-1 will require that IEW-1 operate at an extraction rate of approximately 400 gallons per minute. Central Coast Water Board staff also approved Olin's implementation schedule concerning the intermediate aquifer containment system.

During discussions with Olin over the last nine months, Central Coast Water Board staff has encouraged the strategy of breaking implementation of the intermediate and deep aquifer groundwater containment systems apart. Early on, Central Coast Water Board staff recognized that delays in completing characterization of the deep aquifer would likely also create a delay in intermediate aquifer containment system startup because Olin linked the deep and intermediate hydraulic containment system construction in original designs. In the April 15 Feasibility Study Addendum, Olin agreed to break the intermediate aquifer groundwater containment system apart from the deep system. Uncoupling the two systems allows the intermediate system to start remediating perchlorate in the Intermediate aquifer sooner.

Appendix D to Olin's FS Addendum report provides characterization information regarding the deep aquifer zone. Appendix D indicates that during December 2007 and January 2008, Olin completed installation and groundwater development activities of deep aquifer monitoring wells MW-66 and MW-67. Additionally, Olin performed sampling and hydraulic testing at both well locations.

Based on information collected from these characterization efforts, Olin subdivided the deep aquifer into upper, middle, and lower zones. Olin indicated that characterization of the

upper and middle zones is complete and proposes the installation of a deep aquifer extraction well by the end of 2008 for these two zones.

In Appendix D, Olin also indicated that characterization in the lower deep zone continues. Olin's proposed installation of monitoring wells MW-68, MW-69, and MW-70, as noted in Appendix D, will further characterize the lower deep aquifer.

Central Coast Water Board staff's response to the FS Addendum report approves Olin's deep aquifer zone implementation schedule for completing additional characterization activities within the lower deep aquifer and installing a deep aquifer extraction well in the upper and middle zones of the deep aquifer. In accordance with Olin's implementation schedule, groundwater containment (hydraulic control and cleanup) of the upper and middle deep aquifer zones will begin by November 2009.

Attached (Attachment 1) is a copy of Central Coast Water Board's response letter concerning Olin's April 15, 2008, Intermediate Aquifer Zone Cleanup Work Plan and Area I Plume Migration Control Feasibility Study Addendum.

April 15, 2008, Intermediate Aquifer Zone Cleanup Work Plan: Central Coast Water Board staff completed its review and accepted Olin's Intermediate Aquifer Zone Cleanup Work Plan as complete and in compliance with Cleanup Order No. R3-2007-0077. Olin completed the testing and evaluation of intermediate aquifer zone extraction well (IEW-1). Based on the evaluation results, Olin has confirmed that IEW-1 will achieve hydraulic containment of Priority Zones A and B in the intermediate aquifer upgradient of IEW-1.

- **Onsite Groundwater Treatment and Containment:** Olin began operation of the onsite groundwater treatment system on February 23, 2004, and continues operation of the system without interruption. With the treatment system, groundwater is extracted at a rate ranging from 50 to 175 gallons per minute (gpm). Olin then filters the extracted groundwater, and removes perchlorate with a perchlorate specific ion-exchange process. Subsequently, Olin reinjects the treated groundwater onsite into the shallow aquifer. Olin continues to evaluate the effectiveness of the extraction and re-injection system to ensure effective hydraulic control of the perchlorate plume in the onsite shallow and upper intermediate aquifer. During the first quarter of 2008, Olin extracted and removed perchlorate from approximately 14 million gallons of groundwater. To date, Olin has removed perchlorate from over 231 million gallons of water for a total perchlorate mass reduction of approximately 78 pounds.
- **Status of Monitoring and Reporting Program (MRP) Revisions - Central Coast Water Board staff is updating, revising, and consolidating all monitoring requirements (MRP No. 2003-0168 and MRP No. 2001-161) into a new MRP. Central Coast Water Board staff and Olin recognize the need for a revised MRP that updates and incorporates all the monitoring requirements necessary to effectively monitor perchlorate concentrations over time, plume migration and stability, and cleanup effectiveness. The new MRP will include a detailed monitoring network to ensure that Olin effectively monitors perchlorate concentrations in specific areas of the plume. Staff intends the new MRP will allow for recognition of increasing trends in groundwater with perchlorate concentrations near 6.0 µg/L before these concentrations reach domestic supply wells.**

Central Coast Water Board staff has initiated coordination efforts with Olin and its consultants to issue the new consolidated MRP. Central Coast Water Board staff will finalize the consolidated MRP prior to the July 2008 Board Meeting.

Reports Under Review

Since our last update for the Board, Central Coast Water Board staff has completed or is in the process of completing its review and preparation of comments concerning the following reports:

- January 31, 2008, Annual Remediation Progress Update Report.
- January 30, 2008, Fourth Quarter 2007 Groundwater Monitoring Report, Olin/Standard Fusee Site, 425 Tennant Avenue, Morgan Hill, California (4Q2007 Monitoring Report).
- January 30, 2008, Llagas Subbasin Characterization – 2007, Santa Clara County Olin/Standard Fusee Site, 425 Tennant Avenue, Morgan Hill, California (2007 Characterization Report).
- April 30, 2008 First Quarter 2008 Groundwater Monitoring Report, Olin/Standard Fusee Site, 425 Tennant Avenue, Morgan Hill, California (1Q2008 Monitoring Report).

Upcoming Reports

- Monthly Progress Reports, due by the 10th of every month. Attachment 2 includes the Monthly Progress Report for May 2008.
- Area I 45% Engineering Design Package, due by **August 8, 2008**.
- July 30, 2008 Second Quarter 2008 Groundwater Monitoring Report, Olin/Standard Fusee Site, 425 Tennant Avenue, Morgan Hill, California (2Q2008 Monitoring Report).
- Area I 90% Engineering Design Package, due by **November 28, 2008**.

Status of Groundwater Flow and Mass Transport Model

The Central Coast Water Board retained the services of Department of Toxic Substance Control (DTSC) hydrogeologist Ms. Alice Campbell to serve as an independent third-party consultant to review and evaluate MACTEC's groundwater flow and transport model (model).

On May 5, 2008, Ms. Campbell, on behalf of DTSC provided a memorandum to our staff regarding her comments on the model. In general, Ms. Campbell's evaluation indicates that the model appears to function fairly well at the regional scale, but does not accurately represent the actual location of the plume in some places, and cannot yet be considered very reliable for small-scale features. Ms. Campbell, Olin's consultant, and Central Coast Water Board staff concur that the model is intended to be used as one of many tools to understand the flow system and that the model is intended to be continually improved as Olin collects more data.

Perchlorate Community Advisory Group

The Perchlorate Community Advisory Group (PCAG) meets quarterly in San Martin. The advisory group is a forum for public discussion of the perchlorate plume, associated impacts to the community and potential remedies, and progress toward cleanup. Central Coast Water Board staff solicits advisory group input at key decision points in the investigation and cleanup process.

Central Coast Water Board staff attended the May 29, 2008 evening PCAG meeting held in San Martin. The PCAG meeting consisted of two presentations provided by Olin consultants, MACTEC and Geosyntec. MACTEC provided a status update concerning the Llagas Subbasin investigation and ongoing remediation. Geosyntec presented information contained in the Addendum to the Area I Plume Migration Control Feasibility Study, and focused on the status of groundwater containment systems for the intermediate and deep aquifer zones, as well as the overall cleanup implementation schedule. PCAG representatives and the attending public appreciated material presented in both presentations.

PCAG will hold their next meeting at the San Martin Lions Club on Friday, September 12, 2008, at 2 pm. Central Coast Water Board staff will attend and be available to address questions from the public concerning the ongoing Olin cleanup issues.

Olin Reports and Significant Correspondence can be accessed on our website at:
<http://www.swrcb.ca.gov/rwqcb3/Facilities/Olin%20Perchlorate/Olinsite.htm>

FOLLOW UP:

Central Coast Water Board staff will provide an extensive update to the Board, including a presentation covering the status of cleanup activities and compliance with Cleanup Order No. R3-2007-0077, during our regularly scheduled meeting on December 5, 2008.

ATTACHMENTS

1. Water Board's May 13, 2008, Response to Area I Plume Migration Control Feasibility Study Addendum and Intermediate Aquifer Cleanup Work Plan.
2. Olin's Progress Report #70, dated June 10, 2008.

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