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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
77 WEST JACKSON BOULEVARD
CHICAGO, IL 60604-3590

REPLY TO THE ATTENTION OF:
WU-16J

PROPOSAL TO REISSUE AN EXEMPTION TO CABOT CORPORATION TUSCOLA FOR THE CONTINUED INJECTION OF HAZARDOUS WASTE SUBJECT TO THE LAND DISPOSAL RESTRICTIONS OF THE HAZARDOUS AND SOLID WASTE AMENDMENTS OF 1984

Action: Notice of Intent to Grant an Exemption for the Injection of Certain Hazardous Wastes to Cabot Corporation Tuscola for Two Injection Wells Located at 700 E. U.S. Highway 36, Tuscola, Illinois.

Summary: The United States Environmental Protection Agency (EPA), Region 5, Chicago office, proposes (through this notice) to grant an exemption from the ban on disposal of hazardous wastes (land ban) through two injection wells to *Cabot Corporation Tuscola Plant* (Cabot Corporation) of Tuscola, Illinois. If the exemption is granted, Cabot Corporation may continue to inject Resource Conservation and Recovery Act (RCRA, codified at 42 USC §§ 6901-6992k) regulated hazardous wastes, defined at Title 40 of the Code of Federal Regulations (40 CFR) Part 261 and designated by waste codes D002, F003, and F039 through waste disposal Well No. 2 and Well No. 3.

On March 8, 2007, Cabot Corporation submitted a petition to EPA seeking an exemption from the land ban. The petition is based on a showing under 40 CFR § 148.20(a)(1)(i) that any fluids injected will not migrate vertically out of the Injection Zone or laterally to a point of discharge or interface with an underground source of drinking water (USDW) within 10,000 years. EPA has conducted a comprehensive review of the petition, its revisions, and other materials submitted and has determined that the petition submitted by Cabot Corporation, as revised on September 30, 2008, meets the requirements of 40 CFR Part 148, Subpart C.

Supplementary Information:

I. Background

A. Regulatory Requirements – Section 3004 of the RCRA prohibits the land disposal of untreated hazardous waste. RCRA specifically defines land disposal to include any placement of hazardous waste into an injection well (RCRA Section 3004(k)). Under 40 CFR § 148.20, any person seeking an exemption from that prohibition must submit a petition demonstrating that, to a reasonable degree of certainty, there will be no migration of hazardous constituents from the injection zone for as long as the waste remains hazardous. These petitions, commonly referred to as "no-migration" petitions, must meet the regulatory standards promulgated in 40 CFR Part 148, Subpart C.

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The demonstration of no-migration requires a showing that either 1) injected fluids will not migrate upwards out of the Injection Zone or laterally to a point of contact with a USDW, or 2) before such migration occurs, the injected fluids will no longer be hazardous. The Underground Injection Control (UIC) regulations specify the time frame for which these predictions must be demonstrated as 10,000 years.

B. Facility Information – The two Cabot Corporation injection wells are located at 700 E. U.S. Highway 36, in the City of Tuscola in Douglas County, Illinois. The Illinois Environmental Protection Agency (IL EPA) previously issued permits to the Cabot Corporation facility to dispose of liquid wastes by deep well injection. Since 1966, three injection wells have been drilled on the plant site. Injection Wells No. 2 and No. 3 are currently active, Injection Well No. 1 was plugged and abandoned in 1996. The proposed exemption is based on a long term average injection rate combined for both wells of 400 gallons per minute (gpm) averaged over one-month periods, for a total of 17,280,000 gallons per month. The long term average rate limit is used to bound the area of the waste plume so that the plume will be no larger than the area estimated in the petition. The rate at which Cabot Corporation may inject is also limited by the maximum allowable surface injection pressure. The Cabot Corporation facility in Tuscola is a chemical manufacturing plant producing fumed silica, SiO_2 or silicon dioxide, which is used as an additive in many products.

C. Today's Proposed Decision – On March 8, 2007, Cabot Corporation submitted a petition for exemption from the land disposal restrictions on hazardous waste injection under the Hazardous and Solid Waste Amendments of RCRA. EPA reviewed this submission and requested additional information. Based on the additional supporting documents received on September 30, 2008, EPA has determined that Cabot Corporation has demonstrated, to a reasonable degree of certainty, that any fluids injected will not migrate vertically out of the Injection Zone or laterally to a point of discharge or interface with a USDW within 10,000 years.

II. Basis for Determination

A. Waste Identification and Analysis (40 CFR § 148.22(a)) – Cabot Corporation has petitioned EPA, Region 5, to grant an exemption to allow injection of wastes from the silica production processes. The waste stream is acidic and corrosive – RCRA waste code D002, and it includes the solvent acetone – RCRA waste code F003. It also includes multi-source leachate from the on-site leachate collection system – RCRA waste code F039. Under the proposed exemption, Cabot Corporation can inject only these wastes. A waste analysis was performed and submitted as supplementary information to the no-migration petition. This analysis was conducted in accordance with the quality assurance standards required by 40 CFR § 148.21(a), and adequately describes the characteristics of the waste.

B. Mechanical Integrity Test Information (40 CFR § 148.20(a)(2)(iv)) – In order to confirm that all injected fluids are entering the approved Injection Interval and not channeling up the well bore out of the injection zone, 40 CFR § 148.20(a)(2)(iv) requires the petitioner to submit the results of a successful annulus pressure test and a radioactive tracer survey. These tests demonstrate the mechanical integrity of a well's long string casing, injection tubing, annular seal, and bottom hole cement. The wells at Cabot Corporation passed these tests successfully

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according to the following schedule:

	Annulus pressure test	Radioactive tracer survey
Well #2	5/18/2009	5/20/2009
Well #3	10/5/2009	10/8/2009

C. Local and Regional Geology (40 CFR § 148.21(b)) – Class I hazardous waste injection wells must be located in areas that are geologically suitable. Cabot Corporation provided site-specific geologic, hydrologic, and geochemical information, including descriptions of the depositional environments of the formations, well logs, cross-sections, well and formation tests, and geologic maps, to support the demonstration of no-migration. EPA's evaluation of the structural and stratigraphic geology of the local and regional area determined that the Cabot Corporation facility is located at a geologically suitable site.

1. Identification of Underground Sources of Drinking Water – The lowermost USDW at the site is the Moccasin Springs Formation, with a base at 2700 feet. There are approximately 2078 feet of separation between the lowermost USDW and the Injection Interval, where the waste is emplaced. This separation zone is composed of dolomite, sandy shale, and shale interbedded with siltstone and sandstone, which are predominantly characterized by low permeability at this location, as well as overlying sandstone units.

2. Injection Zone – The Injection Zone must have sufficient permeability, porosity, thickness, and extent to contain the injected fluids. The Injection Zone for the Cabot Corporation facility is composed of the Upper Franconia, Potosi, Eminence and Oneota formations between 4442 and 5400 feet below the surface. The Injection Zone is composed of the Injection Interval, into which the waste is placed, and the overlying Arrestment Interval. Waste is directly emplaced at depths between 4778 and 5400 feet into the Upper Franconia, Potosi, and Eminence formations, which consist predominantly of very fine- to coarse-grained sandstone. It can accept the volume of waste proposed by Cabot Corporation because it has high permeability and porosity.

The Arrestment Interval, between 4442 and 4788 feet, is composed of the Oneota Formation. This is a continuous rock formation of low vertical permeability, which is free of transecting, transmissive faults or fractures over an area sufficient to prevent the upward movement of waste.

3. Confining Zone – (40 CFR § 146.62) – The regulations which specify the minimum criteria for siting Class I hazardous waste injection wells require that the Injection Zone must be overlain by at least one additional formation which can confine the injected fluids. This formation is known as the Confining Zone, and it must be (1) laterally continuous, (2) free of transecting, transmissive faults or fractures over an area sufficient to prevent fluid movement, and (3) of sufficient thickness and lithologic and stress characteristics to prevent vertical propagation of fractures. The Confining Zone at the Cabot Corporation facility is the Shakopee Formation, which is found between 4101 and 4442 feet. It is a 341-foot thick dolomite section with interbeds of sandstone, shale, and siltstone all of which serve to provide containment for the deeper Injection Interval in the area. It has no known transmissive faults or fractures within the

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Area of Review (AOR), and will resist vertical migration because of its low natural permeability.

The Confining Zone must be separated from the lowermost USDW by at least one sequence of permeable and less permeable strata that will provide added layers of protection by either allowing pressure bleed-off (high permeability units), or by providing additional confinement (low permeability units). The "bleed-off" unit is the St. Peter Formation found between 3952 and 4101 feet, which is comprised of dolomitic sandstone having high permeability. It is capable of accepting significant amounts of fluid without developing excessive hydrostatic pressure. The Joachim Formation, found between 3819 and 3952 feet, has low permeability and acts as an effective confining layer between the overlying and underlying aquifers. These rock formations are laterally continuous for hundreds of square miles and provide the required additional layers of protection.

4. Absence of Known Transmissive Faults (40 CFR § 148.20(b)) – There are no known transmissive faults in the Oneota Formation, the stratum within the Injection Zone that will confine fluid movement, or in the overlying Shakopee Formation. The high horizontal permeabilities found in the Injection Interval reflect the dissolution of rock boundaries by the Cabot Corporation acid waste stream and not structural conditions of the formation.

5. Seismicity – Illinois is an area of very low seismic risk. Midwestern earthquakes are infrequent, generally of low magnitude, and have epicenters deep within the Precambrian granitic rocks far below the injection reservoir. There is virtually no possibility of damage to the Cabot Corporation well or leakage of waste from the injection zone as a result of seismic activity.

6. Geochemical Conditions (40 CFR § 148.21(b)(5)) – The petitioner must adequately characterize the injection and Confining Zone fluids and rock types to determine the waste stream's compatibility with these zones. The Injection Zone is composed mainly of permeable dolomite, with some sections of sandy dolomites, shales and sandstone. The Confining Zone is predominantly dolomite and it contains significant sand and shale strata. The sand intervals act as pressure bleed-off zones if necessary. Dolomite, the major constituent of the Injection Interval, is subject to a chemical reaction with the injected waste. This reaction neutralizes within a short time after the injected acid comes into contact with the formations.

D. Wells in Area of Review (AOR) - Under 40 CFR § 146.63, the AOR of Class I hazardous waste wells is a two-mile radius around the well bore, or a larger area specified by EPA based on the calculated cone of influence of the well. The cone of influence is the area within which pressure in the injection interval can raise a column of formation fluid or injected fluid sufficiently to cause contamination of a USDW. At the Cabot Corporation site the pressure increase caused by injection is so small that movement of either the injectate or formation fluids from the injection zone is impossible. Thus the radius of the AOR is 2 miles.

Under 40 CFR § 148.20(a)(2)(ii), a petitioner must locate, identify, and ascertain the condition of all wells within the injection well's AOR that penetrate the Injection Zone or the Confining Zone. Cabot Corporation conducted a well search over the AOR and found that there are three wells penetrating the top of the Confining Zone within this distance. All of these wells were

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properly plugged and abandoned and pose no risk of vertical movement of fluid out of the Injection Zone. Because there are no wells that are improperly plugged, completed, or abandoned, a corrective action plan is not required under 40 CFR § 148.20(a)(2)(iii).

E. Quality Assurance and Quality Control (40 CFR § 148.21(a)) – Cabot Corporation has demonstrated that adequate quality assurance and quality control plans were followed in preparing the petition. Data collected prior to 1988 (before the requirements for the no-migration demonstration were promulgated) were collected in accordance with well-established industry standards, including those for quality control. Procedures for testing carried out since the requirements were promulgated were reviewed and given informal approval as necessary. Cabot Corporation followed an appropriate protocol for locating records for penetrations in the AOR, for collection and analyses of geologic and hydrogeologic data, for waste characterization, and for all tasks associated with the modeling demonstration.

III. No-Migration Demonstration

Cabot Corporation chose to demonstrate that waste injected at the facility will remain in the Injection Zone and will not migrate to a point of discharge or interface with a USDW for a period of at least 10,000 years. This demonstration was based on a showing that a geological model representative of the disposal reservoir and the overlying rock strata would contain the waste constituents within the disposal reservoir for a period of at least 10,000 years under the conditions of the simulation.

A. Model Development (40 CFR § 148.21(a)) – A conceptual model was developed using information from Injection Well #3 developed from logs, core, and other testing carried out during drilling of this well. The original Cabot Corporation exemption petition from 1990 used information from Injection Well #1 and Well #2. Well #1 was plugged and abandoned in 1996. The site-specific information used in the model includes hydrogeologic properties of the various rock layers and formation brines, as well as characteristics of the injected fluid. Where site-specific information was not available or necessary, values from peer-reviewed literature or that have been reported in similar situations were used. Where parameters were uncertain, conservative values were chosen.

Some model parameters are uncertain within a range, yet are critical to the predictions of pressure build-up and waste migration. In accordance with 40 CFR § 148.21(a)(6), a range of values for these parameters was modeled in order to determine the sensitivity of the model to the uncertainties, and to predict the “worst-case scenarios.” Sensitivity analyses were conducted using less-conservative input values for specific gravity, permeability, natural velocity of groundwater flow, dispersitivity, porosity, effective dispersion coefficient, and viscosity, among others. This sensitivity testing indicated that the range of uncertainties does not cause significant differences in the predictions of pressure build-up and waste migration, and that input parameters that underestimate the ability of the Injection Zone to contain the waste still lead to acceptable predictions. The use of conservative assumptions and “worst-case scenario” parameters ensures that the no-migration demonstration is conservative.

The predictions of pressurization and the vertical and lateral movement of waste constituents

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were made using the DuPont suite of subsurface flow and pressure models. The suite includes five different computational routines for predicting the pressure build-up caused by injection, and the lateral and vertical movement of the injected waste. The purpose of the waste transport models is to predict the outer boundary in either the horizontal or vertical direction beyond which no waste will pass during the predicted time period.

Model Verification, Calibration, and Validation (40 CFR § 148.21(a)(3)) – The computer codes used in the DuPont models have been verified by comparing their results with those of analytic and numerical solutions published in literature. The calibration of the pressure model with measured pressures in injection Well Nos. 1, 2, and 3 indicate that the parameters selected are conservative and accurately depict the pressure history in the Injection Interval.

Model Predictions – Four simulated time periods were considered in the demonstration:
- Historical injection (through December 31, 2006)
- 21 years of projected injection (through December 31, 2027)
- Post-injection 30 year recovery period (2028 to 2057)
- Long term (10,000 years).

The operational period included actual historical injection rates through December 31, 2006, and a projected maximum injection rate of 400 gpm for 21 additional years, through December 31, 2027. Offsite injection rates for a nearby Equistar well were also included. Since not all injection rates for Equistar were obtained, a conservative approach was taken to provide a maximum permitted injection rate of 250 gpm for the historical period, and project this forward to 2027. The rate history, together with appropriate assumptions and methods of contaminant transport, determined the distance of waste migration in the year 2027, and the maximum pressure build up in the Injection Zone. The post-operational period was modeled to predict the maximum vertical and horizontal migration of the waste plumes after 10,000 years.

1. Pressure – Maximum pressure buildup, which occurs at the end of the operational period, was predicted by the DuPont Multilayer Pressure Model. The model incorporates 26 rock layers representing stratigraphy at the well site. The individual layers do not necessarily coincide precisely with the formal layering of the stratigraphic column but are specified according to their behavior as functional hydrogeologic units. The maximum predicted pressure increase is 18.88 pounds per square inch at Injection Well #2 and 18.84 pounds per square inch at Injection Well #3. This projection considers maximum injection rates which is extremely conservative, since present day operations use only approximately 50 per cent of permitted injection rate.

2. Vertical Migration – The DuPont Multilayer Vertical Permeation Model in conjunction with the Multilayer Pressure Model predicted the extent of pressure-driven vertical movement during the operational period. The model incorporates 26 rock layers representing stratigraphy at the well site. Conservative assumptions include a high value for the permeability of the shale, equal density of formation brine and the waste stream, and elevated pressure at the top of the Injection Interval (as determined by the pressure model described above). The maximum predicted migration distance is less than 0.1 foot into the 207-foot thick Arrestment Interval.

Cabot Corporation used the DuPont Vertical Permeation Long-Term Model and the DuPont Molecular Diffusion Model to predict the extent of vertical movement of hazardous constituents

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during the 10,000-year post-operational period. Both models incorporate 26 rock layers representing stratigraphy at the well site. A maximum contaminant concentration at the top of the Injection Interval was assumed. As pressures relax in the post-operational period, vertical permeation is only slightly sensitive to the effects of pressure-driven permeation and anthropogenic activities (accounting for 1.3 feet of permeation). Molecular diffusion overwhelmingly accounts for contaminant transport at this time scale, and the predictions of vertical permeation depend primarily on the effective diffusion coefficients of the contaminants in the represented types of rock formations. With the conservative assumption that diffusion occurs freely in the more permeable layers, the maximum predicted vertical permeation is 55 feet into shale and 15 feet for dolomite. These distances represent the net thickness required to reduce the concentration of all contaminants below the health-based standards. Since there is an abundance of both dolomite and shale overlying the Injection Interval, this reduction will be achieved well within the 326 feet thick Arrestment Interval.

3 Lateral Migration – Lateral migration of the waste plume within the Injection Interval was modeled during both the 21-year operational period and the 10,000 year post-operational period. Conservative assumptions were used to maximize the size of the waste plume in order to present "worst case scenarios" of plume migration. The edge of the waste plume is defined as the horizontal distance from the wellbore at which the concentrations of hazardous constituents are at least 1,000 times less than their maximum concentrations at the well head. At this concentration ratio, the predicted outer edge of the plume meets Health Based Limits even if the concentrations of hazardous constituents in the waste stream were much greater than historical values. In the model, the future injection rate from the Cabot Corporation wells is overestimated at 400 gpm, additional contribution from the Equistar injection well of 250 gpm, and the thickness of the Injection Interval is reduced to 280 feet. Dispersion caused by geologic heterogeneities and density differences between injectate and formation brine are incorporated by using a conservative multiplication factor of 2.54, which increases the size of the plume.

Cabot Corporation used the DuPont Basic Plume Model to predict the maximum distance of lateral waste plume migration during the operational period. At the end of the projected 21-year operational period, the distance from the center of the plume to the edge (determined at the one part per thousand concentration ratio) is 9,750 feet. Therefore, the plume would be less than two miles from the well, which is within the AOR.

The DuPont 10,000-Year Waste Plume Model was used to simulate plume migration during the 10,000 year post-operational period. It considered the effects caused by both density drift and the natural groundwater flow within the Injection Interval, as well as hydrodynamic dispersion. Regional hydrogeologic studies of the Potosi-Eminence Dolomite suggest that the rate of regional flow is less than 0.33 ft/year. The formation fluid density is 1.02 g/cc. A range of three waste density cases were modeled:

- a light waste case of 0.990 g/cc
- a neutrally buoyant average waste of 1.02 g/cc
- a heavy waste of 1.34 g/cc

Several runs of the computer model were performed using the above values for waste density. The worst case scenario included a conservative porosity value of 4 per cent and the light waste (0.990 g/cc). Modeling results show that the waste plume in the Potosi-Eminence Dolomite in

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10,000 years will extend approximately 39,000 feet (7.386 Miles) in the northwest direction. This case is considered the most likely long term migration case with conservative plume extent and model inputs.

The nearest point of discharge into a USDW is more than 40 miles away from the facility. Therefore, Cabot Corporation has demonstrated that, to a reasonable degree of certainty, hazardous constituents will not migrate vertically out of the Injection Zone or laterally to a point of discharge in a 10,000 year period.

IV. Conditions of Petition Approval

This proposed reissuance of the land ban exemption for the continued injection of restricted hazardous waste is subject to the following conditions, which are necessary to assure compliance with the standard in 40 CFR § 148.20(a). Non-compliance with any of these conditions is grounds for termination of the exemption in accordance with 40 CFR § 148.24(a)(1). The facility must petition EPA for approval to change any of the following conditions. Petition modifications and reissuance should be made pursuant to 40 CFR § 148.20 (e) or (f).

1) All regulatory requirements in 40 CFR §§ 148.23 and 148.24 are incorporated by reference;

2) The exemption applies to two existing injection wells, Well #2 and Well #3, located at the Cabot Corporation facility at 700 E. U.S. Highway 36, in the City of Tuscola in Douglas County, Illinois;

3) Injection is limited to that part of Upper Franconia, Potosi, Eminence and Oneota formations between 4442 and 5400 feet below the surface;

4) Only wastes denoted by the waste codes D002, F003 and F039 may be injected;

5) The concentrations of the constituents of the injected waste will not exceed the amounts listed in Table 1-1 in the petition document;

6) The volume of wastes injected in any month through the well must not exceed 17,280,000 gallons;

7) This exemption is approved for the 21-year modeled injection period, which ends on December 31, 2027. Cabot Corporation may petition EPA for a reissuance of the exemption beyond that date, provided that a new and complete petition and no-migration demonstration is received at EPA, Region 5, by July 1, 2027.

8) Cabot Corporation shall quarterly submit to EPA a report containing the volume injected that quarter and a fluid analysis of the injected waste which shall indicate the chemical and physical properties upon which the no-migration petition was based, including the physical and chemical properties listed in Conditions 5 and 6 of this exemption approval;

9) Cabot Corporation shall annually submit to EPA a report containing the results of a bottom

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hole pressure survey (fall-off test) performed on Well #2 and Well #3 (alternating years). The survey shall be performed after shutting in the well for a period of time sufficient to allow the pressure in the Injection Interval to reach equilibrium, in accordance with 40 CFR §146.68(e)(1). The annual report shall include a comparison of reservoir parameters determined from the fall-off test with parameters used in the approved no-migration petition;

10) The petitioner shall fully comply with all requirements set forth in Underground Injection Control Permit UIC-011-CC issued by the Illinois Environmental Protection Agency; and

11) Whenever EPA determines that the basis for approval of a petition may no longer be valid, EPA may terminate this exemption and will require a new demonstration in accordance with 40 CFR Section 148.20.

Date: The EPA, Region 5, Chicago office, requests public comments on today's proposed decision. Comments will be accepted until **February 1, 2010**. Comments postmarked after the close of the comment period will be stamped **"Late"**. Late comments do not have standing and will not be considered in the decision process. To request an informational meeting or a public hearing on this proposal, submit your request in writing on or before **February 1, 2010** stating the issues to be raised.

Addresses: Submit written comments and hearing requests by mail to:

Rebecca L Harvey, UIC Branch Chief
United States Environmental Protection Agency, Region 5,
Underground Injection Control Branch (WU-16J)
77 West Jackson Boulevard
Chicago, Illinois 60604-3590

Comments may be submitted by email to harvey.rebecca@epa.gov.

For Further Information: Contact Dana Rzeznik, Lead Petition Reviewer, at the above address, by telephone at (312) 353-6492, or by email at rzeznik.dana@epa.gov

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