

July 28, 2010

FACT SHEET

EPA is proposing to approve an exemption to the land disposal restrictions for the following injection well facility:

Applicant: The Dow Chemical Company

Street Address: c/o Albemarle Corporation West Plant
1550 Highway 371 South
Magnolia, AR 71753

Mailing Address: P.O. Box 150, Bldg. 3502-E
Plaquemine, LA 70765-0150

Permit Number: DWD No. 1

Issuing Office: U.S. Environmental Protection Agency
Region 6
Fountain Place
1445 Ross Avenue
Dallas, TX 75202-2733

Decision

The Environmental Protection Agency (EPA) proposes to approve the Dow Chemical Company (Dow) exemption request to the land disposal restrictions for the following:

1. Approve injection well DWD No. 1, located at the Albemarle West Plant, for injection into the James and Tokio Injection Intervals.
2. Define injection intervals and injection zone with the following correlative depths:

<u>Well</u>	<u>Injection Zone Depths (feet)</u>	<u>Injection Interval</u>	<u>Injection Interval Depths (feet) James and Tokio Formations</u>
DWD No. 1	2180' - 4510'	James	4340' - 4510'
		Tokio	2890' - 3080'

(DWD No. 1 depths referenced to 4/11/06 High Resolution Induction Spectral Density Dual Spaced Neutron Log using Kelly Bushing (KB) depths in feet)

3. Define the density range of the waste stream as 1.00 to 1.05 g/cm³ at 72°F and 1 atmosphere.
4. Define the limit for the cumulative volume injected into DWD No. 1 on a monthly basis as follows:

James: (100 gpm)(1440 minutes/day)(number of days in that month)
Tokio: (100 gpm)(1440 minutes/day)(number of days in that month)

5. Define the operational life of DWD No. 1 to October 1, 2020.
6. Define the list of exempted waste codes as D002, D003, D028, U066, and U067.
7. Define the limiting concentration reduction factor as 1×10^{-7} .

The following explains the derivation of the proposed decision, which is categorized according to the criteria outlined in 40 CFR Part 148. [53 Fed. Reg., 28118, (7/26/88)]

Summary

The EPA land disposal restrictions promulgated under Section 3004 of the Resource Conservation and Recovery Act prohibit the injection of restricted hazardous waste unless a petitioner demonstrates to the EPA there will be no migration of hazardous constituents from the injection zone for as long as the waste remains hazardous. These no migration demonstrations must meet the regulatory standards promulgated in 40 CFR 148 Subpart C. The demonstration includes a description of the well operations, geologic siting, and waste stream characteristics. The demonstration also includes modeling strategies which incorporate all the previously mentioned information and utilize mathematical equations to predict pressure buildup and waste movement. Dow successfully demonstrated no migration for the injection well at the Albemarle West Plant. In accordance with 40 CFR §148.22(a)(4), Dow also submitted a signed certification statement from an authorized representative verifying that all submitted materials are true, accurate, and complete.

The Dow petition described its well operation through a discussion of the well construction, injection pressures, and injection volumes. The site location and geologic conditions were presented through a discussion of the depositional environments, well logs, cross-sections, well tests, geologic maps, and well records. The characteristics of the waste stream were described and evaluated for compatibility with the injection and confining zones. Dow incorporated all this information into a modeling strategy which predicted the pressure buildup and waste movement for the Albemarle site. The waste plume, under worst case conditions, was predicted to move up-gradient 14,000 feet within the James interval in 10,000 years. Maximum vertical waste movement is approximately 362 feet in a mud-filled borehole and 181 feet within the injection zone strata. All of these distances are within the injection zone.

In addition to the reasonably conservative data and assumptions used in the no migration petition, the demonstration is even more conservative as it excludes degradation of the hazardous constituents in the injection zone. Examples of degradation which were not considered in the no migration demonstration are adsorption, oxidation, hydrolysis, temperature, and microbiological degradation.

Therefore, after a detailed and thorough review of Dow's petition for exemption, the EPA proposes that Dow has demonstrated, to a reasonable degree of certainty, that there will be no

migration of hazardous constituents from the injection zone for as long as the waste remains hazardous. This time period is defined by 40 CFR §148.20 as 10,000 years.

The factors considered in the formulation of this proposed petition decision are described below.

Hydrogeology

According to 40 CFR §148.20(a), a petitioner must submit hydrogeologic information in order to study the effects of the injection well activity. Dow provided hydrogeologic information in the petition which demonstrates that Underground Sources of Drinking Water (USDW) are properly protected. The base of the lowermost USDW is at approximately 1305 feet KB depth at the facility.

Artificial Penetrations

Dow submitted updated information on all artificial penetrations (wells) which penetrated the injection or confining zones within the area of review (area within a 2-mile radius of the injection well - 40 CFR §146.63) and the 10,000 year waste plume boundary. Dow submitted information on all artificial penetrations within a 2-mile radius of the injection wells which complies with the Arkansas Department of Environmental Quality's area of review permit requirement for Class I wells. All of these wells were evaluated and are plugged or constructed so that no waste would migrate from the injection zone due to pressure, buoyancy, or molecular diffusion in an artificial penetration. [40 CFR §§148.20(a)(1) & (2)(i)-(iii)]

Mechanical Integrity Testing (MIT) Information

To assure that the wastes will reach the injection interval, a petitioner must submit the results of pressure and radioactive tracer tests according to 40 CFR §148.20(a)(2)(iv). These tests demonstrate mechanical integrity of a well's long string casing, injection tubing, annular seal, and bottom hole cement. The tests confirm that all injected fluids are entering the approved injection interval and that no fluids are channeling up the wellbore out of the injection zone near the wellbore. This petition request demonstrates that Dow's disposal well was tested and satisfies the above criteria:

<u>Well Number</u>	<u>Pressure Test</u>	<u>Radioactive Tracer Survey</u>
DWD No. 1	07/24/09	07/24/09

Regional and Local Geology

Class I hazardous waste injection wells must be located in areas that are geologically suitable. The injection zone must have sufficient permeability, porosity, thickness, and areal extent to prevent migration of fluids into USDWs. The confining zone must be laterally continuous and free of transmissive faults or fractures to prevent the movement of fluids into a USDW and must contain at least one formation capable of preventing vertical propagation of fractures. The Dow facility is sited in an area meeting these geologic criteria.

An evaluation of the structural and stratigraphic geology of the local and regional area determined that the Dow facility is located at a geologically suitable site. The injection zone is

of sufficient permeability, porosity, thickness, and areal extent to meet requirements stated in 40 CFR Part 148. The containment interval is laterally continuous and free of transecting, transmissive faults or fractures over an area sufficient to prevent the movement of fluids out of the injection zone.

The geologic conditions for the Dow site were presented throughout the entire document with extensive discussions of the depositional environments, well logs, cross-sections, well tests, cores, and geologic maps. The geologic cross-sections demonstrated the lateral relationships of the injection and confining zones. This information justified pressure buildup and 10,000 year modeling assumptions. Well pressure falloff tests at DWD No. 1 and from offset injection wells support the injection zone permeability values used in the modeling.

Approximate depths to the tops of the geologic zones are as follows:

<u>Geologic Zone</u>	<u>DWD No. 1</u>
Confining Zone:	2110' - 2180'
Injection Zone:	2180' - 4510'
Injection Intervals: James	4340' - 4510'
Tokio	2890' - 3080'

(DWD No. 1 depths referenced to 4/11/06 High Resolution Induction Spectral Density Dual Spaced Neutron Log using Kelly Bushing (KB) depths in feet)

Modeling Strategy

According to 40 CFR §148.21(a)(3), in demonstrating no migration of hazardous constituents from the injection zone, predictive models shall have been verified and validated, shall be appropriate for the specific site, waste streams, and injection conditions of the operation, and shall be calibrated for existing sites. The modeling strategy for Dow's no migration demonstration consisted of a combination of numerical and analytical models. All the models used were identified as being verified and validated according to the information submitted in the petition request. This information consisted of actual model documentation or references of methods or techniques that are widely accepted by the technical community. The petition document described the predictive models used and demonstrated the above criteria are met.

According to 40 CFR §148.21(a)(5), reasonably conservative values shall be used whenever values taken from the literature or estimated on the basis of known information are used instead of site-specific measurements. Many variables were required to be quantified in order to use the models used in the petition request. All parameters were conservatively assigned to produce worst case conditions for pressure buildup and waste movement.

According to 40 CFR §148.21(a)(6), a petitioner must perform a sensitivity analysis in order to determine the effect of uncertainties associated with model parameters. Dow provided this sensitivity analysis in its petition request. Through conservative model parameter assignments within this analysis, worst case scenarios for pressure buildup and waste movement were investigated and reported.

Dow incorporated two timeframes, the operational and post-operational periods, to complete the modeling demonstration for the petition request. The operational period included the maximum future injection volumes starting from the beginning of well operations through October 1, 2020, to predict the maximum pressure buildup in each injection interval. The 10,000 year post injection period was modeled to predict the maximum vertical molecular diffusion and the horizontal drift of the waste plumes.

To determine appropriate values to be used in the no migration demonstration, Dow reviewed site specific data acquired during the drilling of DWD No. 1, well testing, and mechanical integrity tests. Dow also reviewed offset well information and applicable literature. Appropriate estimation techniques and testing protocols were used in accordance with 40 CFR §148.21(a)(2). A range was assigned to some parameters to maximize their impact on the demonstration. For example, higher permeabilities were assigned to maximize the lateral waste plume movement while lower permeabilities were assigned to maximize the predicted pressure buildup from injection operations in each of the two intervals, James and Tokio. Area offset Class I injection wells were considered in the pressure buildup demonstration. The pressure buildup demonstration used lower transmissibility values and maximum future injection rates to maximize the predicted pressure buildup in both the James and Tokio reservoirs.

A conservative 10,000 year plume demonstration was constructed using worst-case reservoir characteristics for each injection interval, James and Tokio, to project the maximum movement of both the low and high density waste plumes. To maximize plume movement, these demonstrations included thinner net thickness, maximum future injection volumes, and higher mobilities based on historical pressure transient test results from DWD No. 1 and area injection wells. The low density plume used the low end of the requested density range and did not include a background gradient to maximize the updip plume movement.

A vertical diffusion demonstration was included in this petition request that calculated the maximum vertical movement into intact strata and a mud-filled wellbore. The demonstrations (lateral plume and diffusion) demonstrated the injected waste stream for each interval will not migrate vertically upward out of the injection zone or laterally within the injection zones to a point of discharge or interface with a USDW for the required 10,000 year demonstration period.

Quality Assurance

According to 40 CFR §148.21(a)(4), the Dow petition must demonstrate that proper quality assurance and quality control plans were followed in preparing the petition demonstrations. Specifically, Dow followed appropriate protocol in identifying and locating records for artificial penetrations within the area of review (AOR). Information regarding the geology, waste characterization [40 CFR §148.21(a)(1)], hydrogeology, reservoir modeling, and well construction was adequately verified or bounded by worst-case scenarios within the no migration petition demonstration.

Geochemistry and Injected Waste Compatibility

According to 40 CFR §148.21(b)(5), a petitioner must describe the geochemical conditions of the well site. The physical and chemical characteristics of the injection zone and the formation

fluids in the injection zone were described in the petition. This description included a discussion of the compatibility of the injected waste with the injection zone. Dow also provided evaluations which demonstrated that the waste stream would not adversely alter the confining capabilities of the injection and confining zones.

Characteristics of Injected Fluids

According to 40 CFR §148.22(a), the characteristics of the injection waste stream must be adequately described. These characteristics are described in the petition and the descriptions are adequate and complete. The demonstration included injectate waste analysis that conformed to the standards outlined in 40 CFR §148.21(a)(1).

Results

1. Operational Life

End of Operational Life: October 1, 2020

Maximum Incremental Pressure Buildup:

James: 678 psi in DWD No. 1 at 4326 feet BGL

Tokio: 686 psi in DWD No. 1 at 2876 feet BGL

2. 10,000 Year Post-Injection Period:

Background Gradient: 0 ft/yr updip and 0 ft/yr downdip

Waste Density Effects Considered: Yes

Movement Due to Hydrocarbon Production Considered: There is no hydrocarbon production from injection intervals.

Waste Concentration Reduction Factor: 1×10^{-7}

Maximum Lateral Waste Movement:

Light Plume:

Approximately 14,000 feet (2.65 miles) updip in a northeast direction from DWD No. 1 in the James interval.

Heavy Plume:

Approximately 6,000 feet (1.14 miles) downdip in a southwest direction from DWD No. 1 in the James interval.

Maximum Vertical Waste Movement:

Approximately 181 feet through intact strata and 362 feet in a mud-filled borehole.

Proposed Petition Approval Conditions

This proposed petition of exemption approval to allow the injection of restricted hazardous wastes is subject to the following conditions, which are necessary to assure that the standard in 40 CFR §148.20(a) is met. Noncompliance with any of these conditions is grounds for termination of the exemption in accordance with 40 CFR §148.24(a)(1). This proposed exemption is applicable to the Dow injection well, DWD No. 1, located at the Albemarle West Plant in Magnolia, Arkansas.

1. Injection of restricted waste shall be limited to the following injection zone:

Well
DWD No. 1

Depth of Injection Zone
2180' - 4510' KB

(DWD No. 1 depths referenced to 4/11/06 High Resolution Induction Spectral Density Dual Spaced Neutron Log using Kelly Bushing (KB) depths in feet)

The injection interval shall be defined by the following correlative log depths:

<u>Well</u>	<u>Injection Interval</u>	<u>Depth of Injection Interval</u>
DWD No. 1	James	4340' - 4510' KB
	Tokio	2890' - 3080' KB

(DWD No. 1 depths referenced to 4/11/06 High Resolution Induction Spectral Density Dual Spaced Neutron Log using Kelly Bushing (KB) depths in feet)

2. For DWD No. 1, the cumulative monthly volume injected into the James interval during any given month shall not exceed that calculated by multiplying 100 gpm x 1440 minutes/day x the number of days in that month. For DWD No. 1, the cumulative monthly volume injected into the Tokio interval shall not exceed that calculated by multiplying 100 gpm x 1440 minutes/day x the number of days in that month.
3. The facility shall cease injection into DWD No. 1 by October 1, 2020.
4. The characteristics of the injected waste stream shall for DWD No. 1 at all times conform to those discussed in Section 6 of the 2003 Petition document for DWD No. 1. The density of the wastestream for DWD No. 1 shall remain within a range from 1.00 to 1.05 g/cm³ at 72°F and 1 atmosphere.
5. The proposed approval for injection is limited to the following hazardous wastes: D002, D003, D028, U066, and U067
6. The facility must petition for approval to inject additional hazardous wastes which are not included in Condition No. 5, above. The facility must also petition for approval to increase the concentration of any waste which would necessitate the recalculation of the limiting concentration reduction factor and the extent of the waste plume. Petition reissuances and modifications should be made pursuant to §148.20 (c) or (f).
7. Dow shall annually submit to EPA the results of a bottom hole pressure survey for DWD No. 1. This 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 §146.68(e)(1). The annual report should include a comparison of reservoir parameters determined from the falloff test with parameters used in the approved no migration petition.
8. Upon the expiration, cancellation, reissuance, or modifications of the Arkansas Department of Environmental Quality's Underground Injection Control permit for Well No. DWD No. 1, this exemption is subject to review. A new demonstration may be required if

information shows that the basis for granting the exemption is no longer valid under 40 CFR §148.23 and §148.24.

In addition to the above conditions, this proposed petition for exemption approval is contingent on the validity of the information submitted in the Dow petition request for an exemption to the land disposal restrictions. Any final decision is subject to termination when any of the conditions occur which are listed in 40 CFR §148.24, including noncompliance, misrepresentation of relevant facts, or a determination that new information shows that the basis for approval is no longer valid.