Waste Isolation Pilot Plant

Compliance Certification Application

Reference 102

Butcher, B.M. 1996.
Memo to M.S. Tierney, RE: QAP9-1 Documentation of the Initial Waste Water Content for the CCA, January 29, 1996. WPO 30925.

Submitted in accordance with 40 CFR §194.13, Submission of Reference Materials.

WPO 30925

INFORMATION ONLY

Sandia National Laboratories

Albuquerque, New Mexico 87185-1341

date: January 29, 1996

to: M. S. Tierney, 6741, MS 1328

B. M. Butcher

from: B. M. Butcher, 6748, MS 1341

subject: QAP 9-2 Documentation of the Initial Waste Water Content for the CCA

In accordance with QAP 9-2, the attached memo describes the initial water content as 1.5% maximum saturation, 0.06% mean saturation, and 0 minimum saturation. The mean saturation value was computed from information in the attached memo provided by J. R. Elliot. These saturation values are based on a porosity value for the waste of 0.681, the same as that used for SPM-2. Initial waste water content based on porosities derived from more recent BIR inventory estimates are slightly smaller, but not different enough to merit changing the recommended values.

Copy to:

MS 1330 SWCF-A: 1.1.01.2.3; DRM; QA
MS 1320 E. J. Nowak (6831)
MS 1328 Palmer Vaughn, (6749)
MS 1341 J. T. Holmes (6748)
MS 1341 L. Dotson (6747)
MS 1341 B. M. Butcher (6748) day file

WPO300198

Sandia National Laboratories

Albuquerque, New Mexico 87185-1341

date: December 6, 1995

to: M. E. Fewell, 6749, MS 1328

B. M. Butcher

from: B. M. Butcher, 6748, MS 1341

subject: Initial Waste Water Content

The attached MATHCAD file is an estimate of the initial water content of waste for PA calculations (no backfill). The maximum initial saturation is estimated to be 1.5%, the mean saturation is 0.06%, and the minimum saturation is 0.

These values have been reviewed and found acceptable.

M. E. Fewell 12/6/95

Mert Fewell Date

Copy to:

MS 1330 SWCF-A:1.1.1.2.3:DRM:QA
MS 1341 B. M. Butcher (6748) day file

Copy w/o attachment to:

MS 1341 A. L. Stevens (67 06)
MS 1341 D. C. Coffey (6706)
MS 1341 J. T. Holmes (6748)
MS 1328 Hong-Nian Jow (6706)
MS 1328 Palmer Vaughn (6749)

File C: mathcad arch1 bsat5 is used to compute the initial saturation of the waste assuming no backfill. 10/16/95, B. M. Butcher

Initial total room volume: 3644 m3
Intiial waste porosity: 0.681

All calculations are for a single disposal room

For the waste, the internal volume of a 55 gallon drum is 0.2082 m3, and there are 6804 drums.

The volume of the waste in the room is $Vwaste := 0.2082 \cdot 6804$

$Vwaste = 1.4166 \cdot 10^3$

The volume of solids in the waste is

$Vs := (1 - 0.681) \cdot Vwaste$

$Vs = 451.8931$

The void volume in the waste is

$Vwv := 0.681 \cdot Vwaste$

$Vwv = 964.6997$

$$\frac{Vwv}{Vwv + Vs} = 0.681$$

The maximum allowable free liquid (assumed pure water) according to the WAC is 1% volume, which we assume is water.

The maximum volume of water in the waste is therefore:

$Vwmax := 0.01 \cdot Vwaste$ $Vwmax = 14.1659 m^3$

$$S0max := \frac{Vwmax}{Vwv}$$ $S0max = 0.0147$ $S0max \cdot 100 = 1.4684$

Since saturation is dimensionless, it can be computed for a single disposal room and then applied to the entire repository

Assume that the minimum water content of the waste is 0. The minimum value of saturation would be:

$Vwmin := 0$ $S0min := 0$

Assuming the INEL average value of 0.18109 pints per drum, with 1 pint = 0.0004731 m^3, the average volume of water is:

$$Vwavg := 4.731 \cdot \begin{bmatrix} -4 \\ 10 \end{bmatrix} \cdot 6804 \cdot 0.18109$$ $Vwavg = 0.5829$

$$S0avg := \frac{Vwavg}{Vwv}$$ $S0avg = 6.0425 \cdot 10^{-4}$

Summary $S0avg \cdot 100 = 0.0604$

In the waste (void volume 965 m3) :

$S0min \cdot 100 = 0$
$S0avg \cdot 100 = 0.0604$ percent water (not brine)
$S0max \cdot 100 = 1.4684$ percent water (not brine)

In terms of the entire room

$Vv := 3644 - Vs$ $Vv = 3.1921 \cdot 10^{3}$

$S0min \cdot 100 = 0$

$S0avg \cdot \frac{Vwv}{Vv} \cdot 100 = 0.0183$

$S0max \cdot \frac{Vwv}{Vv} \cdot 100 = 0.4438$

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check

$.181 \cdot \frac{6804}{8} \cdot \frac{0.003785}{Vwv} = 6.0399 \cdot 10^{-4}$ $\frac{.2082}{55} = 0.0038$

The maximum saturation could be increased slightly. Assume that there is a 5% probability that there is a sealed container filled with water in a combustible or metallic waste drum (2722 drums of each in a room: see for exampoe the memo by Beraun defining disposal room parameters in the 1992 Volume 3 Appendix). Also assume that the maximum sealed container is 1 gallon in volume (0.003785 m3), and that there is at most one such container per drum.

ndm := 2722

ndc := 2722

$Vcont := 0.003785 \cdot (ndm + ndc) \cdot 0.05$ $Vcont = 1.0303$ m3"

$S0max := \frac{Vwmax + Vcont}{Vwv}$ $S0max = 0.0158$ $S0max \cdot 100 = 1.5752$

which is slightly different from what it would be without this contribution:

or S0max*100 = 1.4684

WPO 21203

From : Environment, Safety and Health
WN : 234-8291
Date : October 8, 1993
Subject: FREE LIQUID CONTENT OF WASTE STORED AT IDAHO NATIONAL ENGINEERING LABORATORY AND DISPOSITIONED AS WASTE ISOLATION PILOT PLANT CERTIFIED

DA 93-10052

To : L. R. Fitch

cc: W. H. Bodily
R. F. Kehrman

Post-it™ brand fax transmittal memo 7671 | # of pages ▸ 4

To Barry Butcher	From P. Vaughn
Co.	Co.
Dept.	Phone #
Fax #	Fax #

With regard to the determination of estimates on the amount of free liquid resident within the TRU waste certified for disposal at the WIPP repository, a standard approach is to bound the estimate and thereby provide the underpinnings for establishing numerous best case/worst case scenarios. Several compelling arguments for taking this approach can be made. First and foremost, without sufficient data to establish an accurate statistical sampling of percent free liquid content by volume within the TRU waste inventory, bounding the problem is the only alternative. Secondly, should the performance assessment using the bounding values for free liquid demonstrate a benign repository response to the resulting gas generation, this result in conjunction with supporting laboratory-scale, bin-scale, and alcove-scale test data would constitute compelling evidence to justify the WIPP's request for a no migration determination during the disposal phase.

Unfortunately, by incorporating multiple bounding conditions including a free liquid content of one (1) gallon per each 55-gallon drum received into the Waste Isolation Pilot Plant (WIPP), Sandia National Laboratory's (SNL's) calculations have not unequivocally demonstrated the repository's response function to be independent of the generated gas pressure. In light of this result and the fact that there now exists a large waste characterization data base resident at the Idaho National Engineering Laboratory (INEL), it is now possible for SNL to input a more realistic estimate for the percent free liquid volume into their performance assessment calculations. Although the INEL data base is specific to waste derived from operations at the Rocky Flats Plant (RFP), there is a growing consensus that this information be used as the first step in a "phased approach" to resolving issues associated with gas generation - even if it should only relate to waste received from past RFP operations in addition to the current decommissioning and decontamination activities.

This examination of the EG&G/INEL data is the most exhaustive inquiry to date into the question of how much free liquid is resident in waste dispositioned as WIPP certified. Attached are the results of this inquiry. Several items need to be clarified in order to preclude any misinterpretations. First, the attached report only accounts for free residual liquid within the waste packages. No accounting of absorbed or adsorbed liquids is made in this report. Second, only waste dispositioned as WIPP certified is included in this report; i.e., of the approximately 17,000 drums examined, 9,171 drums were certified as acceptable per the WIPP Waste Acceptance Criteria (WAC). The majority of those waste drums rejected were on the basis they constituted Low Level Waste (LLW). Only a minority of the waste drums were rejected due to the presence of various non-conforming waste forms. Third, input to this study was also solicited from the RFP; however, due to the fact their data was not readily accessible from a computer data base, the submittal of this report on a timely basis did not allow for that additional information to be included at this time.

Upon perusing the data, the most striking observation is the small average liquid volume measured for the thirty four content codes. These values can be seen to span the range from 0.00000 to 0.39208 pints with an average of the averages equal to 0.18109 pints. Since the WAC prohibits free liquids in excess of one volume percent of the 55-gallon container, this equates to an upper bound of 0.55 gallons or 4.4 pints per 55-gallon drum. Comparison of these values indicates that on average the free residual liquid volume observed within this data base is much less than the upper bound established by the WAC. Also of importance is the fact that the free residual liquid volume averages are small relative to their corresponding standard deviations. This is indicative of a skewed frequency distribution. Thus, Waste Compliance would like to suggest that SNL use a Poisson distribution with a mean equal to the average specified above in place of their previous probability distributions for available water.

It is the intent of Waste Compliance to continue working with both INEL and RFP personnel to refine this data. Specifically a determination of the nature of the skewed frequency distributions is needed in order to more accurately model the residual free liquid volume parameter for each content code. In addition, since the LLW and TRU waste forms are in many instances derived from the same processes, it is of interest to determine if the water content of these waste categories are the same. An inquiry of this nature will provide insight on the relative importance of process knowledge to the characterization of waste.

For purposes of validating the information in this report, cognizant personnel to contact at EG&G/INEL that were instrumental in this study include Ms. Diane Hartley (208) 526-2484 and Mr. Tom Clements (208) 526-0664. Personnel to be contacted at EG&G/RFP include Mr. Jerry O'Leary (303) 966-3268 and Mr. Steve Tallman (303) 966-2257.

J. R. Elliott, Manager
Waste Compliance

alt

Attachment

PORT NO.: POLDSR01

AVERAGE AMOUNT AND STANDARD DEVIATION OF LIQUID IN CONTAINERS DESTINED FOR WIPP

CONTENT CODE	NUMBER OF CONTAINERS	AVERAGE LIQUID (PINTS)		STANDARD DEVIATION OF LIQUID
1	3,733	0.14808		0.4
2	42	0.34048		0.6
3	550	0.13800		0.4
4	283	0.11131		0.4
7	2,621	0.32030		0.6
292	186	0.33710	1.01	0.6
300	344	0.00087		0.0
302	6	0.00000		0.0
303	72	0.00000		0.0
312	7	0.00000		0.0
320	93	0.00000		0.0
330	49	0.08571		0.4
335	4	0.12500		0.2
336	60	0.15667		0.4
337	101	0.39208	.952	0.5
338	13	0.00000		0.0
339	78	0.00000		0.0
370	1	0.00000		0.0
371	83	0.00000		0.0
374	2	0.00000		0.0
377	1	0.00000		0.0
409	5	0.00000		0.0
411	10	0.00000		0.0
414	4	0.00000		0.0
432	72	0.05139		0.1
440	205	0.06000		0.1
441	2	0.00000		0.0
442	241	0.00249		0.0
464	1	0.00000		0.0
480	268	0.04739		0.2
481	29	0.02759		0.1
490	1	0.00000		0.0
900	1	0.00000		0.0
970	3	0.00000		0.0
	9,171			