# Washington State Toxic Waste Designation Walkthrough

## INTRO

Determining if a product is a “Washington State Toxic Waste” at the end of its life cycle is a confusing, difficult process for both retailers and regulators. Fortunately, Smarter Sorting has automated this state of Washington toxicity classification process to ease this burden for concerned stakeholders.

This white paper will examine the state’s Equivalent Concentration calculation (which is the foundation of the classification process) and the classification of WT01 and WT02 waste codes. The methodology described here has been thoroughly reviewed by technical analysts at the Washington State Department of Ecology.

## COMMON TERMS

“Washington State Toxic Waste” classification requires knowledge of toxicology and measures of toxicity.

A standard measure of toxicity (and the one utilized in Washington) is the median lethal dosage. The median lethal dose of a substance is the amount of substance required to kill 50 percent of a test population. Median lethal dosage is abbreviated as LD50 (Lethal Dosage), or LC50 (Lethal Concentration). The units of measurement are milligrams of substance per kilogram of test population bodyweight, and milligrams of substance per liter of volume, respectively.

Exposure routes refer to the administration of the toxic substance in question. For example, an oral exposure route indicates that the substance was administered orally to a test population.

Rats, rabbits, and fish are the most common test populations/species utilized in toxicity studies.

When these elements are combined, an example of a toxicological data point would be: oral, rat, LD50, 100mg/kg. This description indicates that when the substance was administered to a sample rat population orally (in quantities conforming to the ratio of 100mg of substance per kilogram of bodyweight of each rat), half of the test population of rats died.

Additionally, chemical names can be sloppily indexed. Therefore, chemicals are often referred to by their Chemical Abstracts Service number, or CAS number.

Finally, the Washington Administrative Code, abbreviated WAC, is mentioned numerous times in this article.

**Let’s begin.**

## THE PRODUCT

We will examine a common household product to provide a concrete example of how to demonstrate our Washington State methodology.


The first thing we need to know is what is in the product.

For purposes of calculating Washington State toxicity levels, consult Section 3 ("Composition/Information on Ingredients") of the product's Safety Data Sheet (SDS) to determine all potentially hazardous ingredients.

***Material Safety Data Sheet***

according to ANSI Z400.1- 2004 and 29 CFR 1910.1200

SC Johnson
A FAMILY COMPANY

**WINDEX® MULTISURFACE ANTIBACTERIAL**

Version 4.0

Revision Date 10/12/2012

Print Date 11/01/2012

MSDS Number 350000004960
SITE_FORM Number
30000000000000004266.002

**3. COMPOSITION/INFORMATION ON INGREDIENTS**

Hazardous chemicals present at or above reportable levels as defined by OSHA 29 CFR 1910.1200 or the Canadian Controlled Products Regulations are listed in this table:

| Chemical Name | CAS-No. | Weight percent |
|---|---|---|
| Isopropanol | 67-63-0 | 1.00 - 5.00 |
| Ethyleneglycol Monohexylether | 112-25-4 | 1.00 - 5.00 |
| Lactic Acid | 79-33-4 | 0.10 - 1.00 |

The Safety Data Sheet shows that our sample product has three main components, each listed with concentration ranges.

## THE DATA

The Washington Administrative Code (WAC) 173-303-100 (5)(b)(i) suggests consulting three main databases to calculate Equivalent Concentration. These include Ecotoxicology Database (ECOTOX), Hazardous Substances Data Bank (HSDB), and the Registry of Toxic Effects of Chemical Substances (RTECS). These databases contain toxicological study information indexed by chemical and typically by the CAS number.

Further specificity is also provided regarding what kinds of toxicity studies should be employed. Four toxicological exposure routes—with specific parameters for each toxicity study—must be met. These include the following:

**Oral Ingestion**

- Exposure route = oral
- Species = rat
- Study type = LD50
- Units = mg/kg

**Dermal Contact**

- Exposure route = dermal
- Species = rabbit (or rat)
- Study type = LD50
- Units = mg/kg

**Inhalation Hazards**

- Exposure route = inhalation
- Species = rat
- Study type = LC50
- Units = mg/L

**Aquatic Toxicity**

- Exposure route = water-solution
- Species = fish
  - Salmonid
  - Minnow
  - Other
- Study type = LC50
- Units = mg/L
- Risk Assessment = Acute

These parameters ensure the comparison of correct data points when calculating Equivalent Concentration.

If we inspect our normalized toxicity database for all relevant toxicity data for our three-ingredient sample product, it looks like this:

| chemical_name | cas_number | value | unit | species | exposure | tox_type |
|---|---|---|---|---|---|---|
| Ethylene glycol | 112-25-4 | 720 | mg/kg | rabbit | dermal | LD50 |
| Ethylene glycol | 112-25-4 | 810 | mg/kg | rabbit | dermal | LD50 |
| Ethylene glycol | 112-25-4 | 830 | mg/kg | rat | oral | LD50 |
| Isopropanol | 67-63-0 | 4900 | mg/L | harlequinfish | water | LC50 |
| Isopropanol | 67-63-0 | 7100 | mg/L | harlequinfish | water | LC50 |
| Isopropanol | 67-63-0 | 4200 | mg/L | harlequinfish | water | LC50 |
| Isopropanol | 67-63-0 | 8970 | mg/L | carp | water | LC50 |
| Isopropanol | 67-63-0 | 9280 | mg/L | carp | water | LC50 |
| Isopropanol | 67-63-0 | 6550 | mg/L | fathead minnow | water | LC50 |
| Isopropanol | 67-63-0 | 11160 | mg/L | fathead minnow | water | LC50 |
| Isopropanol | 67-63-0 | 11130 | mg/L | fathead minnow | water | LC50 |
| Isopropanol | 67-63-0 | 11830 | mg/L | fathead minnow | water | LC50 |
| Isopropanol | 67-63-0 | 9640 | mg/L | fathead minnow | water | LC50 |
| Isopropanol | 67-63-0 | 10600 | mg/L | fathead minnow | water | LC50 |
| Isopropanol | 67-63-0 | 10400 | mg/L | fathead minnow | water | LC50 |
| Isopropanol | 67-63-0 | 51.045 | mg/L | rat | inhalation | LC50 |
| Isopropanol | 67-63-0 | 72.6 | mg/L | rat | inhalation | LC50 |
| Isopropanol | 67-63-0 | 72.6 | mg/L | rat | inhalation | LC50 |
| Isopropanol | 67-63-0 | 12870 | mg/kg | rabbit | dermal | LD50 |
| Isopropanol | 67-63-0 | 12800 | mg/kg | rabbit | dermal | LD50 |
| Isopropanol | 67-63-0 | 12800 | mg/kg | rabbit | dermal | LD50 |
| Isopropanol | 67-63-0 | 5500 | mg/kg | rat | oral | LD50 |
| Isopropanol | 67-63-0 | 4710 | mg/kg | rat | oral | LD50 |
| Isopropanol | 67-63-0 | 5840 | mg/kg | rat | oral | LD50 |
| Isopropanol | 67-63-0 | 5280 | mg/kg | rat | oral | LD50 |
| Isopropanol | 67-63-0 | 5045 | mg/kg | rat | oral | LD50 |
| Isopropanol | 67-63-0 | 5045 | mg/kg | rat | oral | LD50 |
| Lactic Acid | 79-33-4 | 130 | mg/L | rainbow trout | water | LC50 |

Notice there are multiple rows per chemical and study type. This is due to the variable nature of toxicity testing: one can get varying answers for the same test because tests are conducted on different test populations.

## TOXIC CATEGORIES

To calculate the Equivalent Concentration, we need to know the toxic category of each chemical. To determine this, find the minimum value per chemical and per exposure route, and apply the inequalities in the "Toxic Category Table" (pictured below) as listed in WAC 173-303-100(5)(b)(i). Here we walk through the methodology in detail.

First, isolate the data per exposure route and chemical.

Below is the data for oral exposure for isopropanol, one of our sample product's ingredients:

| chemical_name | cas_number | value | unit | species | exposure | tox_type |
|---|---|---|---|---|---|---|
| Isopropanol | 67-63-0 | 5500 | mg/kg | rat | oral | LD50 |
| Isopropanol | 67-63-0 | 4710 | mg/kg | rat | oral | LD50 |
| Isopropanol | 67-63-0 | 5840 | mg/kg | rat | oral | LD50 |
| Isopropanol | 67-63-0 | 5280 | mg/kg | rat | oral | LD50 |
| Isopropanol | 67-63-0 | 5045 | mg/kg | rat | oral | LD50 |

Notice there are five distinct LD50 values.

When a chemical has multiple toxicity values per exposure route, use the minimum value to determine the "Toxic Category."

This exposure route's minimum value is shaded red here: a toxicity value of 4710 mg/kg.

Consult the table to arrive at the appropriate toxic category for oral exposure.

TOXIC CATEGORY TABLE

| Toxic Category | Fish $LC_{50}$(mg/L)[b] | Oral Rat $LD_{50}$(mg/kg) | Inhalation Rat $LC_{50}$(mg/L)[c] | Dermal Rabbit $LD_{50}$(mg/kg) |
|---|---|---|---|---|
| X | <0.01 | <0.5 | <0.02 | <2 |
| A | 0.01 - <0.1 | 0.5 - <5 | 0.02 - <0.2 | 2 - <20 |
| B | 0.1 - <1 | 5 - <50 | 0.2 - <2 | 20 - <200 |
| C | 1 - <10 | 50 - <500 | 2 - <20 | 200 - <2000 |
| D | 10 - 100 | 500 - 5000 | 20 - 200 | 2000 - 20,000 |

[a] These four test endpoints are defined in WAC 173-303-040.

[b] Fish $LC_{50}$ data must be derived from an exposure period greater than or equal to twenty-four hours. A hierarchy of species $LC_{50}$ data should be used that includes (in decreasing order of preference) salmonids, fathead minnows, and other fish species.

[c] Inhalation Rat $LC_{50}$ data must be derived from an exposure period greater than or equal to one hour.

After reviewing the "Toxic Category Table," we see that for oral exposure, LD50 values between 500 and 5000 mg/kg are designated as toxic category "D." Isopropanol is thus an oral toxic category "D" chemical.

Repeat the process for isopropanol on dermal exposure, with red values indicating the minimums.

| chemical_name | cas_number | value | unit | species | exposure | tox_type |
|---|---|---|---|---|---|---|
| Isopropanol | 67-63-0 | 12870 | mg/kg | rabbit | dermal | LD50 |
| Isopropanol | 67-63-0 | 12800 | mg/kg | rabbit | dermal | LD50 |
| Isopropanol | 67-63-0 | 12800 | mg/kg | rabbit | dermal | LD50 |

Dermal toxicity between 2000 and 20000 mg/kg corresponds to dermal toxic category “D.” Isopropanol is thus a dermal toxic category “D” chemical.

Repeat the process for inhalation exposure.

| chemical_name | cas_number | value | unit | species | exposure | tox_type |
|---|---|---|---|---|---|---|
| Isopropanol | 67-63-0 | 51.05 | mg/L | rat | inhalation | LC50 |
| Isopropanol | 67-63-0 | 72.60 | mg/L | rat | inhalation | LC50 |
| Isopropanol | 67-63-0 | 72.60 | mg/L | rat | inhalation | LC50 |

Inhalation values between 20 and 200 mg/L correspond to an inhalation toxic category “D.” Isopropanol is thus an inhalation toxic category “D” chemical.

And once more for aquatic exposure.

| chemical_name | cas_number | value | unit | species | exposure | tox_type |
|---|---|---|---|---|---|---|
| Isopropanol | 67-63-0 | 4900 | mg/L | harlequinfish | water | LC50 |
| Isopropanol | 67-63-0 | 7100 | mg/L | harlequinfish | water | LC50 |
| Isopropanol | 67-63-0 | 4200 | mg/L | harlequinfish | water | LC50 |
| Isopropanol | 67-63-0 | 8970 | mg/L | carp | water | LC50 |
| Isopropanol | 67-63-0 | 9280 | mg/L | carp | water | LC50 |
| Isopropanol | 67-63-0 | 6550 | mg/L | fathead minnow | water | LC50 |
| Isopropanol | 67-63-0 | 11160 | mg/L | fathead minnow | water | LC50 |
| Isopropanol | 67-63-0 | 11130 | mg/L | fathead minnow | water | LC50 |
| Isopropanol | 67-63-0 | 11830 | mg/L | fathead minnow | water | LC50 |
| Isopropanol | 67-63-0 | 9640 | mg/L | fathead minnow | water | LC50 |
| Isopropanol | 67-63-0 | 10600 | mg/L | fathead minnow | water | LC50 |
| Isopropanol | 67-63-0 | 10400 | mg/L | fathead minnow | water | LC50 |

The minimum value of 4200 mg/L exceeds the threshold of 100 mg/L for aquatic toxic category “D,” and thus is uncategorized for aquatic exposure.

Now we have completely categorized one of our sample product's ingredients and summarized the information into this table.

| chemical_name | cas_number | oral_category | dermal_category | inhal_category | aquatic_category |
|---|---|---|---|---|---|
| Isopropanol | 67-63-0 | D | D | D | - |

Replicating the process for all three chemicals in our sample product, we arrive at a table of toxic categories:

| chemical_name | cas_number | oral_category | dermal_category | inhal_category | aquatic_category |
|---|---|---|---|---|---|
| Ethylene glycol | 112-25-4 | D | C | - | - |
| Isopropanol | 67-63-0 | D | D | D | - |
| Lactic Acid | 79-33-4 | - | - | - | - |

Before utilizing the Equivalent Concentration formula, the final step is to determine each chemical's "final toxic category."

To do this, take the most severe toxic category per chemical from among the four exposure routes. Toxic categories range from "X" as the most severe to "D" as the least severe.

Table of Final Toxic Categories

| chemical_name | cas_number | oral_category | dermal_category | inhal_category | aquatic_category | final_category |
|---|---|---|---|---|---|---|
| Ethylene glycol | 112-25-4 | D | C | - | - | C |
| Isopropanol | 67-63-0 | D | D | D | - | D |
| Lactic Acid | 79-33-4 | - | - | - | - | - |

## EQUIVALENT CONCENTRATION

Once you've got the final toxic categories for each of your ingredients and their concentration amounts, you are ready to plug them into the Equivalent Concentration (E.C.) equation.

$$\text{Equivalent Concentration (\%)} = \frac{\sum X\%}{1} + \frac{\sum A\%}{10} + \frac{\sum B\%}{100} + \frac{\sum C\%}{1000} + \frac{\sum D\%}{10{,}000}$$

To arrive at the final E.C., divide the cumulative concentration present in each of the toxic categories by its associated constant and take the sum.

Because none of our ingredients are in toxic categories "X," "A," or "B," the first three terms of the equation will be 0 percent. Similarly, one of our ingredients does not have a final toxic category and thus does not contribute to the E.C.

**E.C.(%) = (0% / 1)**
**+ (0% / 10)**
**+ (0% / 100)**
**+ (5% / 1000)**
**+ (5% / 10000)**
**= 0.55%**

The table below displays the E.C. calculation in a different form.

| chemical_name | cas_number | concentration max(%) | final_category | E.C. |
|---|---|---|---|---|
| Ethylene glycol | 112-25-4 | 5.00 | C | 0.50% |
| Isopropanol | 67-63-0 | 5.00 | D | 0.05% |
| Lactic Acid | 79-33-4 | 1.00 | - | 0.00% |
| | | | TOTAL | 0.55% |

## WT01, WT02, OR NEITHER?

With the E.C. calculated, we can now designate whether the sample product is considered “Washington State Toxic Waste” or not.

WAC sections 173-303-100(5)(iii)(A) through WAC 173-303-100(5)(iii)(D) state the Equivalent Concentration thresholds for the relevant toxic dangerous waste codes.

We have summarized them here in this table:

| WAC Section | E.C. Threshold | Toxic Waste Code |
|---|---|---|
| 173-303-100(5)(iii)(a) | Less than 0.001% | Non-Toxic |
| 173-303-100(5)(iii)(b) | Between 0.001% and 1.0% | WT02 |
| 173-303-100(5)(iii)(d) | Greater than 1.0% | WT01 |

Our sample product has an E.C. of 0.55 percent and is thus considered “Washington State Toxic Waste,” with a code of “WT02.”

## CONCLUSION

As you can see, the process for calculating the Equivalent Concentration of a single product is multi-layered and complicated. It should be clear that conducting a book designation for a state of Washington waste code by hand would be incredibly laborious and error-prone. Smarter Sorting has automated this procedure and shown you how its platform functions in exacting detail. Smarter Sorting exists to take the uncertainty out of this onerous classification process by delivering accurate, reliable, and consistent Washington State waste codes.