

The Aquatox Paradox

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Many consumer brands have made a commitment to themselves and their customers that they will not support or perform animal testing for ingredients they use or products they formulate. This is bold, inspirational, and challenging. A large, but relatively unknown, part of the challenge is regulatory authorities that require animal testing in order to assess aquatic toxicity for waste management. If you do not test, then your product must be managed as toxic to the aquatic environment. In this strange scenario, cruelty-free = toxic...hence, the aquatox paradox.

It should be noted that testing is not inherently bad, and this is especially true when introducing novel chemical constituents to the environment. That being said, testing does not always need to involve live animals and testing products for the sake of testing, regardless of how well studied, needs to be re-evaluated.

Aquatic Toxicity

Imagine a laboratory room filled with tanks of water, 10 fish per tank, all being dosed at various concentrations of chemicals or products to determine lethality. The objective of this test is to assess aquatic toxicity or, in some cases, prove that a product is not toxic. Each test requires a minimum of 40 fish (2 concentrations, performed in duplicate, with 10 fish per

sample) in order to determine the lethal concentration that will kill 50% of the test population in a 96-hour period (a.k.a. LC50). If the results are not conclusive then additional testing is necessary.

This test method, also known as the “fish kill test”, is not pleasant to imagine and immediately prompts two questions:

1. Why is this being done?
2. Isn't there an alternative?

Why is this being done?

Simply put, select regulatory authorities have decided that physical testing is the only way to truly determine if a waste or a potential waste could be hazardous to the aquatic environment. No ifs, ands, or buts about it. If you do not perform this test, then your product will default to being toxic and that brings a whole suite of obligations as well costs to developing and managing a product.

For example, toxic products become subject to regulation, which requires extensive documentation, reporting, training, and pass-through costs to manage incineration (destruction with high heat) in order to remain compliant. For a product like a cosmetic, failure to perform a test will automatically classify the item as toxic, and it will be incinerated regardless of whether it truly is toxic or not.

Here's where it gets messy. Sending non-toxic products to incineration is much more expensive than other waste management methods like landfilling, recycling, and donation. Furthermore, incinerating products and their packaging creates unwanted persistent organic pollutants (POPs) such as dioxins, which are known carcinogens according to the EPA.

In summary, some authorities require that the fish kill test be performed in order to prove a material is not toxic. However, for the vast majority of consumer products, this test is unnecessary and inhumane — we can do better than this.

Isn't there an alternative?

These testing requirements have been around since the 1980s and have not been seriously reviewed since that time. Meanwhile, in the past 20 years, the UN has developed and advocated for a reduction in animal testing through the use of pre-existing toxicity data and mathematical equations. Using math, one can estimate the aquatic toxicity based on relevant ingredients and the available toxicity data for those ingredients.

Smarter Sorting champions this approach and is already doing this at scale. Our tech services consume ingredients and concentration ranges, fetch statistically valid ecotox data from our databases, model the concentrations within each authority's approved calculation method (see images below), and provide a classification that can be used in lieu of testing on animals.

Regulatory action

Today there are only two US states that use aquatic toxicity to determine hazardous waste characteristics, Washington and California. However, only Washington has taken regulatory action to allow for aquatic toxicity to be calculated as an alternative to physically testing every product formulation.

One interesting aspect to California is that other toxicological endpoints for dermal, oral, and inhalation toxicity already allow for calculation using ingredient-level data. It is unclear why the line has been drawn for calculating aquatic toxicity, especially given the acceptance for such methods both internationally and domestically. In addition to Washington, the EU has adopted the calculation methods that were developed through the UN and the Globally Harmonized System of Classification and Labelling of Chemicals (GHS) — arguably the world's foremost chemical classification scheme.

Washington "book designation" for dangerous waste

An acceptable alternative to performing fish bioassay for formulated products is to enter ingredient-level toxicity data into an overall Equivalent Concentration toxicity formula to determine the waste classification. Washington has taken a unique approach in that they categorize 5 tiers of toxicity (X, A, B, C, D from most to least hazardous) and then weight these categories to account for the more hazardous constituents.

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

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 LC₅₀ data must be derived from an exposure period greater than or equal to twenty-four hours. A hierarchy of species LC₅₀ data should be used that includes (in decreasing order of preference) salmonids, fathead minnows, and other fish species.

c Inhalation Rat LC₅₀ data must be derived from an exposure period greater than or equal to one hour.

EU Technical Guidance on the Classification of Waste (summation approach)

The EU also permits the use of calculation to perform classification. The EU CLP classification is their basis, which is an adoption of GHS. Using summation, they identify a material as an acute aquatic toxic ("Hazard Property Ecotoxic 14") when the sum of acute 1 ingredients is $\geq 25\%$. Before summation, sub-mixtures may apply the additivity method, which estimates the acute toxicity using the equation shown below.

"Waste which contains one or more substances classified as aquatic acute assigned the hazard statement code H400 in accordance with Regulation (EC) No 1272/2008 and the sum of the concentrations of those substances equals or exceeds the concentration limit of 25 %. A cut-off value of 0,1 % shall apply to such substances. [$\sum c (H400) \geq 25\%$]"

Summation Method (mixtures)

Sum of the concentrations (in %) of ingredients classified as:	Mixture is classified as:
Acute 1 x M-factor $\geq 25\%$	Acute 1



The calculated toxicity may be used to assign that portion of the mixture a short-term (acute) hazard category which is then subsequently used in applying the summation method

Additivity Method (sub-mixtures)

$$\frac{\sum C_i}{L(E)C_{50_m}} = \sum \frac{C_i}{L(E)C_{50_i}}$$

where:

- C_i = concentration of ingredient i (weight percentage);
- $L(E)C_{50}$ = LC_{50} or EC_{50} for ingredient i, in (mg/l);
- n = number of ingredients, and i is running from 1 to n;
- $L(E)C_{50_m}$ = $L(E)C_{50}$ of the part of the mixture with test data;

As is typical in the world of regulations, consumer demand and science are ahead of the curve and interested stakeholders need to proactively seek change. Changing regulations and accepting new science takes time, effort, and the budget to do so...but it is worth it. Data alone is not enough to drive change and make the world better. This is why Smarter Sorting is leading the discussion on regulatory reform to eliminate unnecessary animal testing. Right now we are supporting Assembly Bill 1793 in California ([AB-1793 Quirk](#)) to enable the use of humane, math-driven methods to determine aquatic toxicity.

Additionally, with the passage of this bill, non-toxic products will be diverted away from incineration in favor of more sustainable end-of-life pathways such as recycling and donation. Not only will this drastically reduce a retailer's waste bill, but it will also reduce the overall environmental impact of the product and increase its circularity. Retailers and brands can communicate this positive impact to their customers and investors to further promote their ESG strategy and goals.