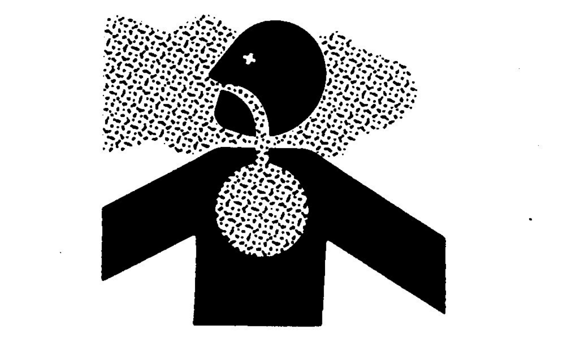
Fugacity swimming

Alethia Bautista Campos	A01167791
Arturo Bolaños Colín	A01373599
Cesáreo Roldán Ortiz	A01260362
Krystell Magallanes Pichardo	A01168048
Dante Sánchez Vera	A01167912
Víctor Tomás Pérez Vieyra	A01168057

Introduction

- There is a risk associated with exposure to disinfection byproducts (DBPs)
- DBPs are formed when organics present in water react with the disinfectants.
- Cancer, respiratory effects and reproductive effects.



Fugacy Model

- Most prevalent DBPs in water are trihalomethanes (THMs) and haloacetic acids (HAAs).
- Three main exposure routes: ingestion, inhalation and dermal contact.
- Models to estimate exposures to DBPs in swimming pools: SWIMODEL and a fugacity exposure model.

Fugacity model

The escaping tendency of a chemical to leave one medium in preference for another.

$$C = f \cdot Z$$

Where:

C = concentration
f = fugacity
Z = fugacity capacity

Fugacity Model

- ➔ The use of fugacity in contaminant fate modeling allows simultaneous consideration of all the media and processes occurring in the environment.
- ➔ Fugacity capacities are calculated from the physco-chemical properties
- ➔ Sometimes, depending on its concentration, we need to consider them in our balance equations
- ➔ Variability (aleatory uncertainty) is in every case of these model

Uncertainity of the model

Transport between water and air.

$$D_{12} = \frac{1}{\frac{1}{k_G A_{12} Z_1} + \frac{1}{k_L A_{12} Z_2}} \quad (2)$$

where

- k_G is the air side mass transfer coefficient,
- A_{12} is the surface area of the water,
- Z_1 and Z_2 are the fugacity capacities for the air and water compartments, respectively; and
- k_L is the water side mass transfer coefficient.

Fuzzy-Based Models.

TABLE II. CALCULATED VALUES OF K_G AND K_L

	Pool 1	Pool 3	Pool 5	Source of Equation
k_G cm/hr	27.0	25.7	25.1	[25], [26]
	51.0	48.5	47.5	[27] [28]
	76.5	59.2	66.6	[29] [28]
	26.9	25.6	25.1	[30] [28]
	26.6	26.6	26.6	[31] [32]
	73.7	63.0	66.1	[26]
	43.8	34.5	38.2	[28] [30]
	Pool 1	**Pool 3**	**Pool 5**	**Source of Equation**
k_L cm/hr	0.58	0.58	0.58	[24]
	12.1	12.1	12.1	[33]
	61.1	46.2	41.5	[34]

There are four basic steps in the DSW algorithm:

- Select a value α in the membership functions.
- Find the intervals in the input membership functions that correspond to this α.
- Using interval operations, compute the interval for the output membership function for the selected α-cut level.
- Repeat these steps for different values of α to build fuzzy result.

$$D_{12} = \frac{1}{\frac{1}{[20,99] \times A_{12} \times Z_1} + \frac{1}{[0.58, 61.1] \times A_{12} \times Z_2}}$$

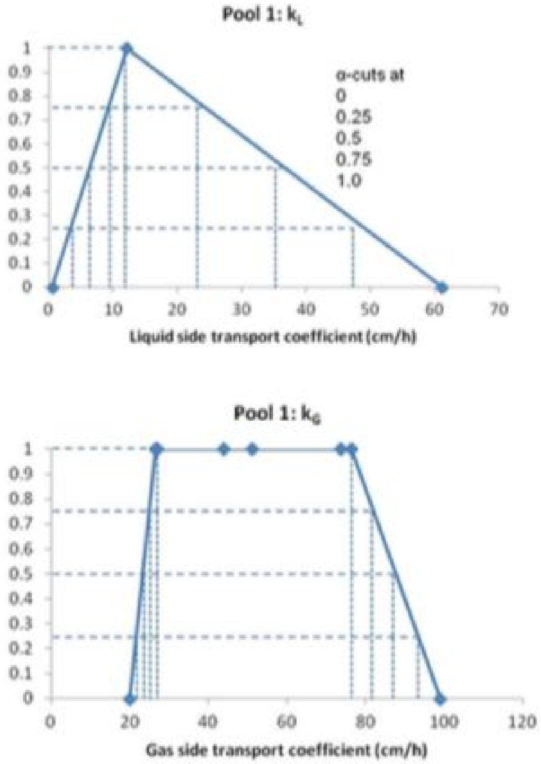


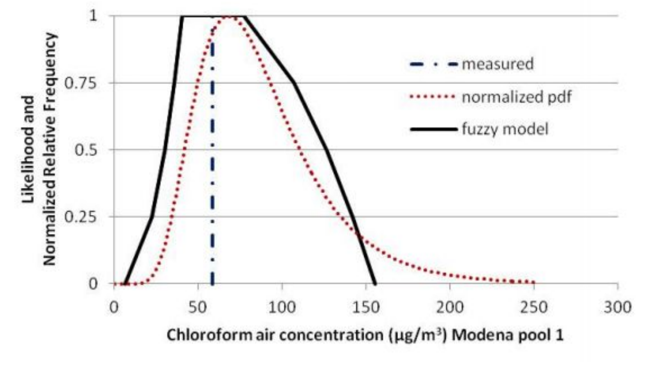
Figure 1. α-cuts on k_G and k_L fuzzy membership functions (Modena Pool 1)

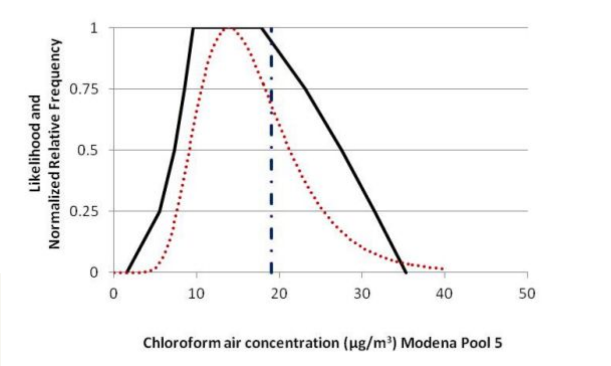
TABLE III. INTERVAL VALUES FOR K_G AND K_L

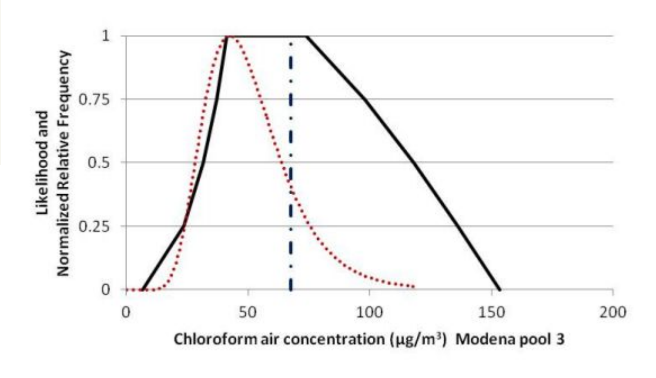
		Pool 1		**Pool 3**		**Pool 5**	
	α-cut levels	***left***	***right***	***left***	***right***	***left***	***right***
k_G (cm/hr)	0	20	99	20	99	20	99
	0.25	21.7	93.4	21.4	90.0	21.3	90.9
	0.5	23.3	87.7	22.8	81.0	22.5	82.8
	0.75	25.0	82.1	24.2	72.0	23.8	74.7
	1	26.6	76.5	25.6	63.0	25.1	66.6
	α-cut levels	***left***	***right***	***left***	***right***	***left***	***right***
k_L (cm/hr)	0	0.58	61.1	0.58	46.2	0.58	41.5
	0.25	3.47	48.9	3.47	37.7	3.47	34.2
	0.5	6.36	36.6	6.36	29.2	6.36	26.8
	0.75	9.25	24.4	9.25	20.6	9.25	19.5
	1	12.14	12.1	12.14	12.1	12.14	12.1

Fuzzy model results

In a similar fashion, we use this fuzzy results to calculate fugacity, mass transport and use those results to calculate the concentration of Chloroform in the air and in the pool.







gure 2. Results of fuzzy model, probabilistic model and measured air concentrations

Conclusions

- ➔ Fuzzy based models, for identifying DTP
- ➔ DSW Algorithm (Fugacity due to mass transport)
- ➔ There is a bigger amount of Chloroform on the pools that use DBPs and their outsides, that by long time could cause sickness.
- ➔ Fuzzy-based environmental models require less computational complexity while providing a better representation of our true understanding of a model when data are lacking