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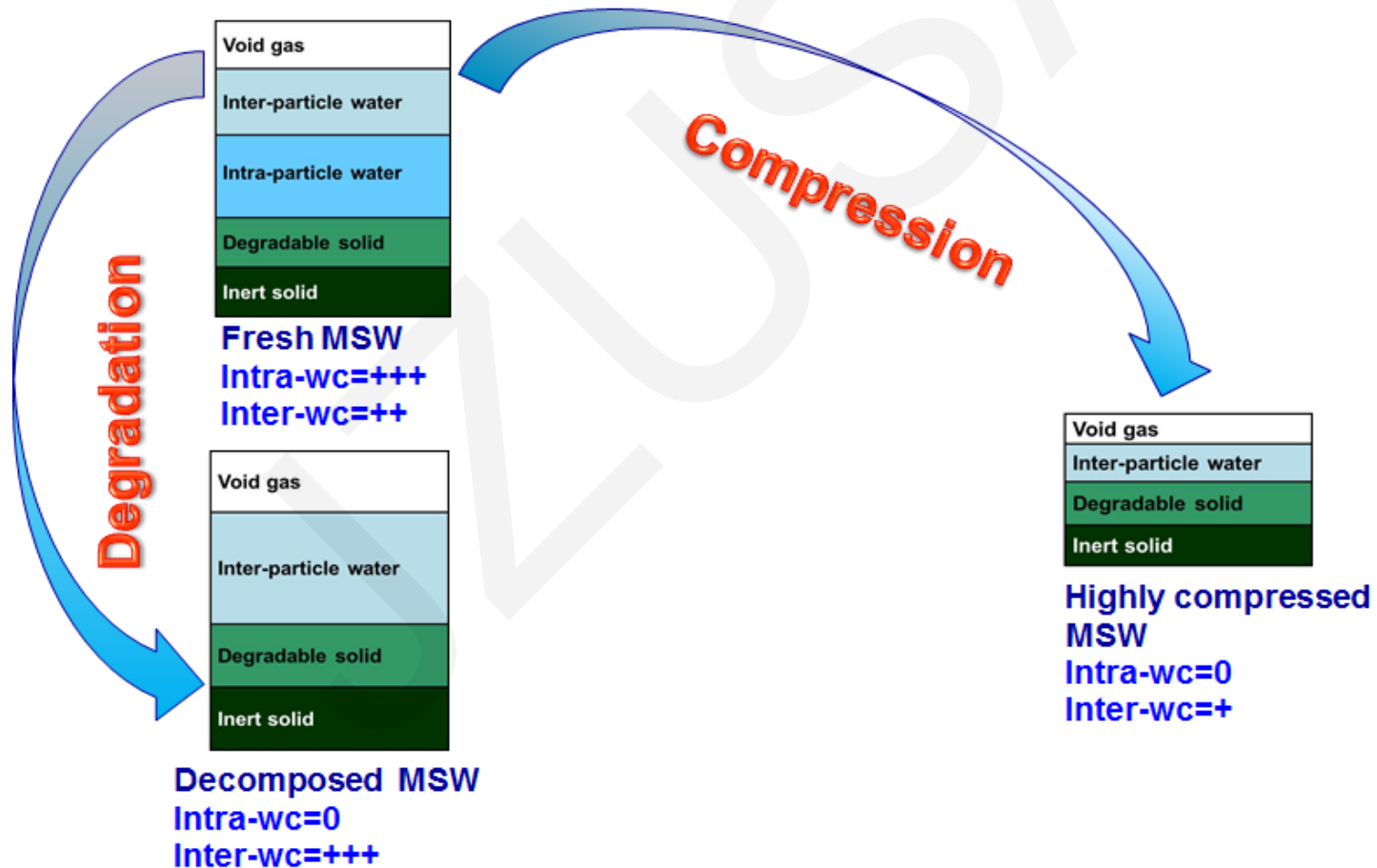
## **Time- and stress-dependent model for predicting moisture retention capacity of high-food-waste-content municipal solid waste: based on experimental evidence**

**Key words:** Moisture retention capacity (MRC), Municipal solid waste (MSW), Stress, Degradation, Model

# Introduction

## Moisture Retention Capacity (MRC)

- MRC of MSW is significantly depend on stress compression and degradation time



# Material and methods

## □ Summary of MRC tests

- Experimental aim: to characterize the variation of MRC with degradation time and overburden stress

No.	Waste type	Stress range (kPa)	Degradation condition	Duration time (d)
A-1, A-2	HFWC-MSW	10	(40±3) ° C, anaerobic	998
A-3	HFWC-MSW	10	(40±3) ° C, semi-aerobic	998
A-4	HFWC-MSW	10	Ambient air temp., anaerobic	998
B-1	HFWC-MSW	50–400	(40±3) ° C, anaerobic	400
C-1, C-2	HFWC-MSW	10–400	Degradation inhibited	20
D-1, D-2	NFWC-MSW	10–400	Degradation inhibited	16
E-1, E-2	D-MSW	10–400	Ambient air temp.	14

**HFWC-MSW:** high food waste content MSW

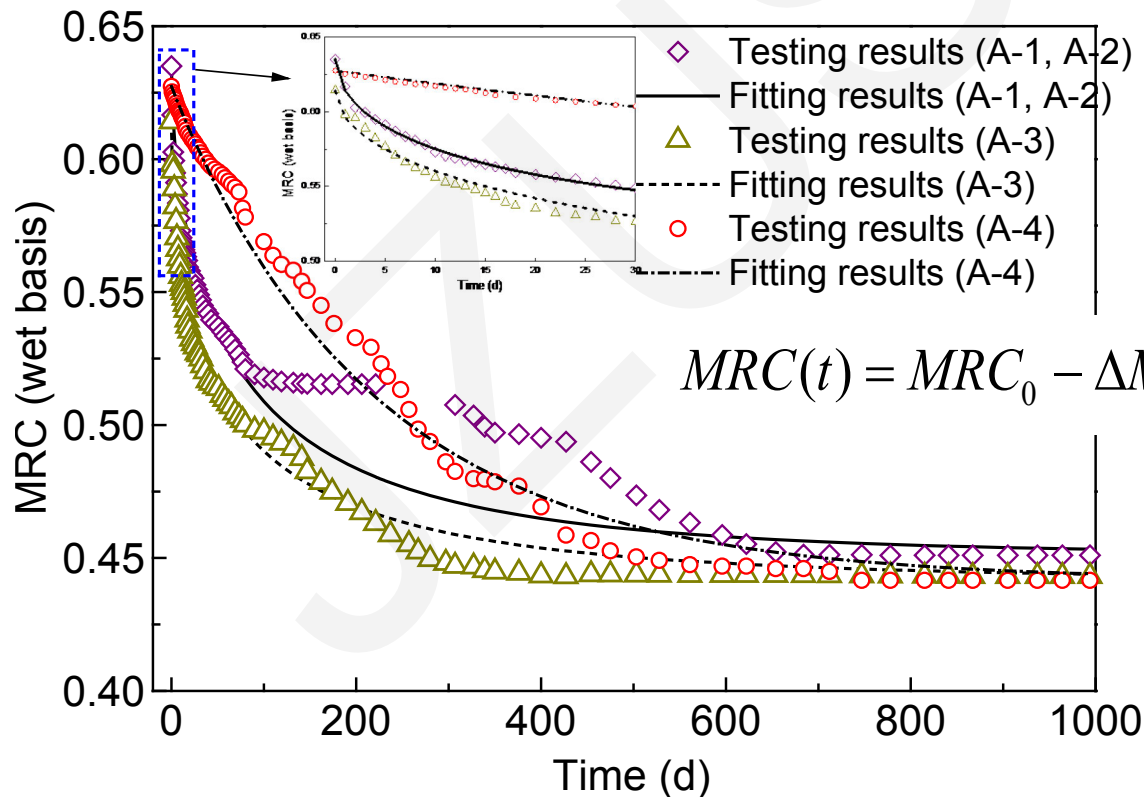
**NFWC-MSW:** no food waste content MSW

**D-MSW:** decomposed MSW

# Results and Analysis

## □ Variation of MRC with degradation time

- MRC of fresh HFWC-MSW decreased exponentially with degradation time under a sustained stress
- Higher waste temperature or oxygen introduction would result in a faster declining of MRC.

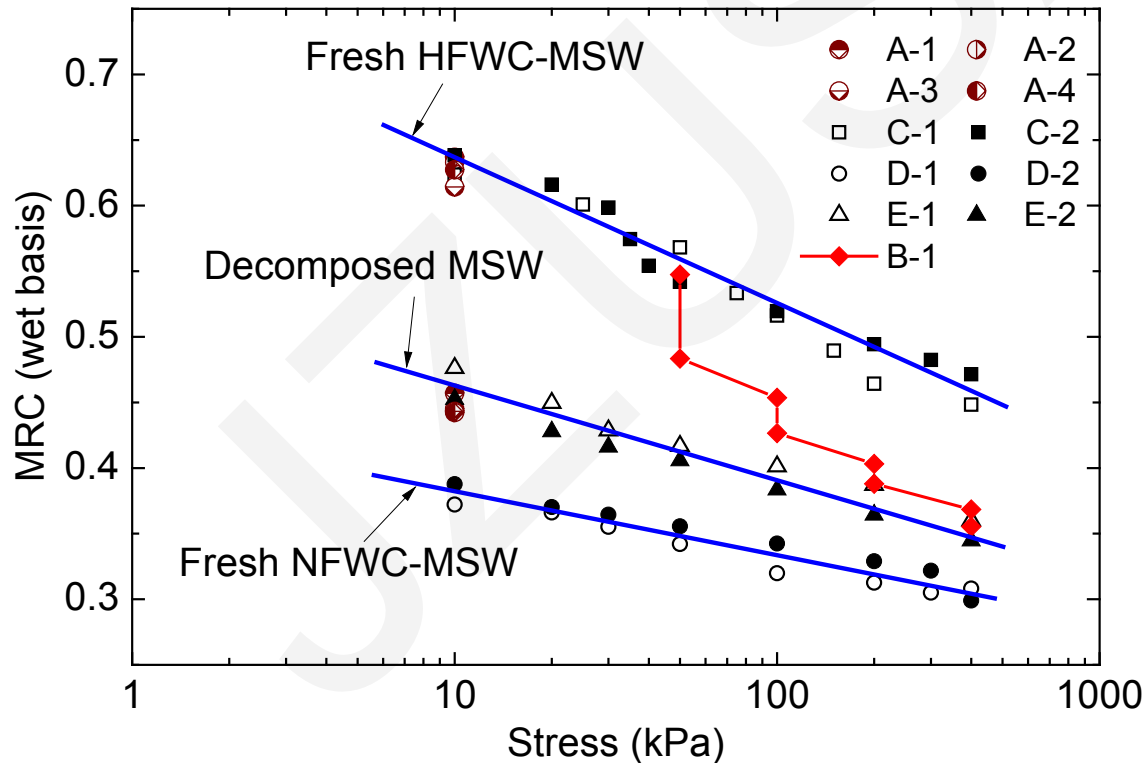


$$MRC(t) = MRC_0 - \Delta MRC \left[ 1 - \exp(-mt^n) \right]$$

# Results and Analysis

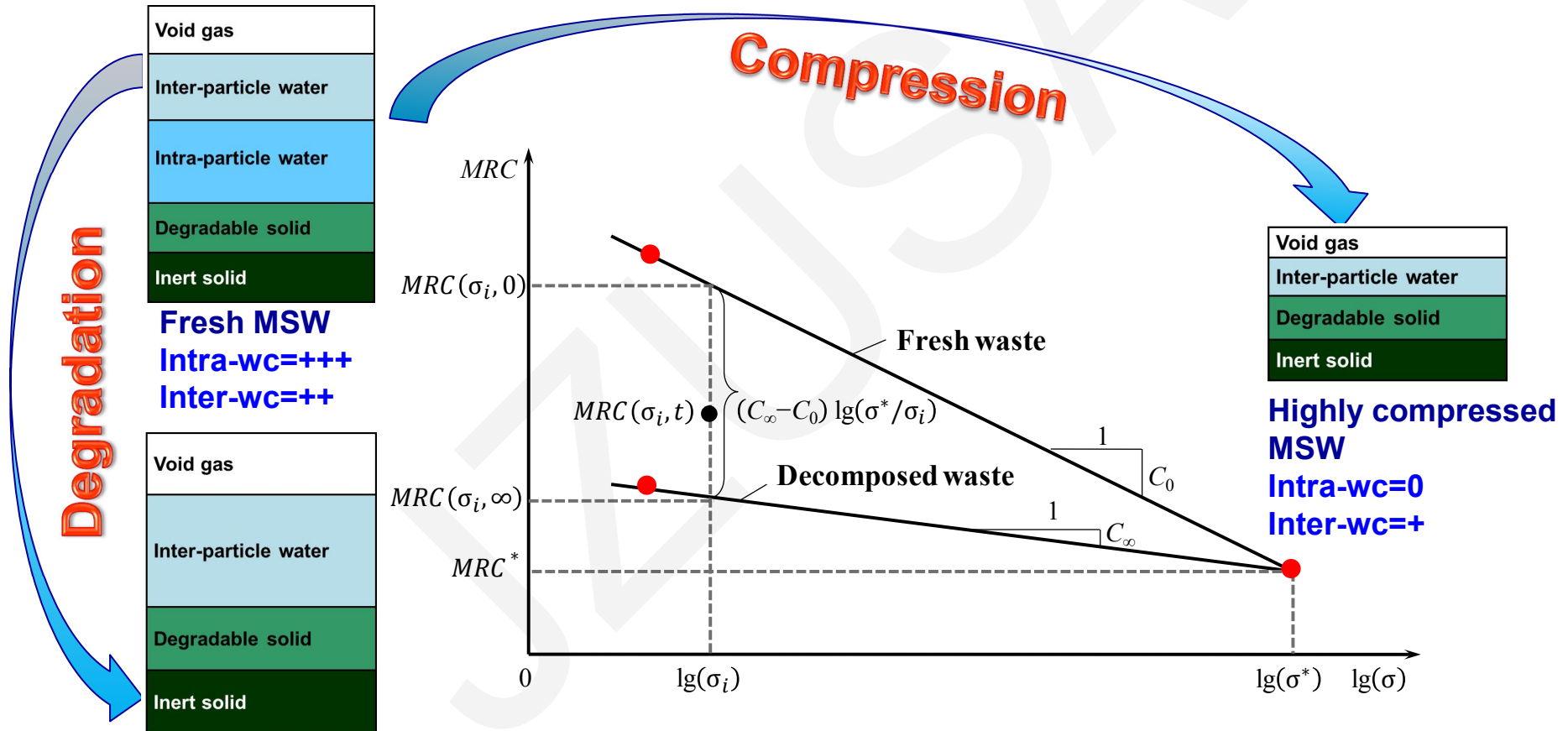
## □ Variation of MRC with incremental stresses

- MRC decreased linearly with an increase of logarithmic stress
- MRC seemed to be independent of stress path



# Mathematical Model for MRC

- A time- and stress-dependent model was proposed for predicting the MRC of HFVC-MSW

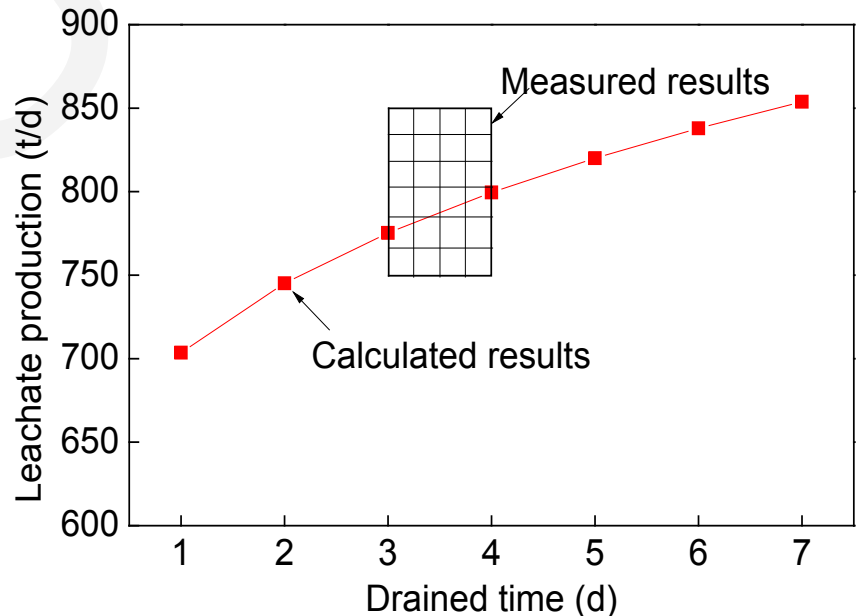
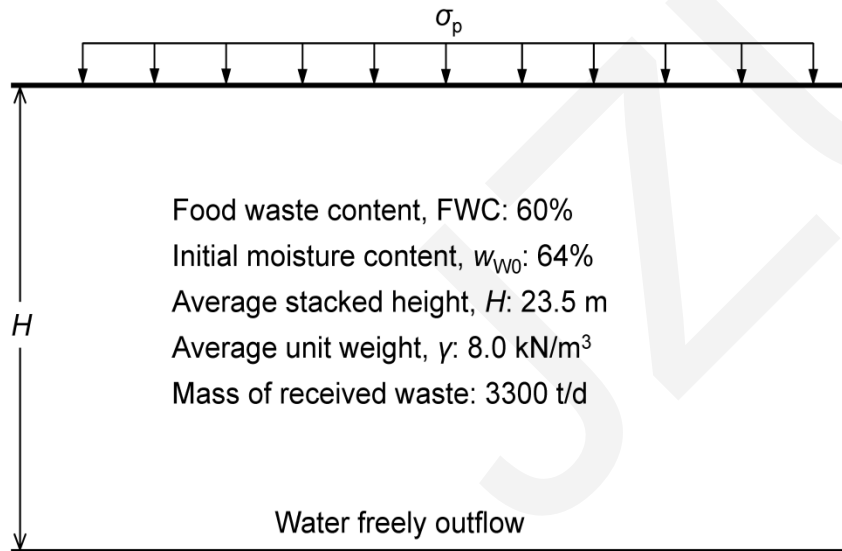


$$MRC(\sigma, t) = MRC^* - C_0 \lg\left(\frac{\sigma^*}{\sigma}\right) - (C_\infty - C_0) \lg\left(\frac{\sigma^*}{\sigma}\right) (1 - e^{-mt^n})$$

# Engineering Application

## □ Laogang incineration plant, Shanghai

- Calculated results are in agreement with measured data from the pre-treatment container
- Combining degradation-enhancing measures with stress-increasing measures is recommended in the rapid dewatering of an HFWC-MSW pile



# Conclusions

- MRC of fresh HFWC-MSW decreased with degradation time under a sustained stress. This process can be described with the equation  $MRC(t) = MRC_0 - \Delta MRC[1 - \exp(-mt^n)]$ . Rising of waste temperature and introduction of oxygen would result in a faster decline of MRC for fresh HFWC-MSW.
- MRCs decreased with stress for fresh HFWC-MSW, fresh NFWC-MSW, and decomposed MSW. These processes can be described with the equation  $MRC(\sigma) = A - B \lg \sigma$ . The variation of MRC was independent of stress path in terms of stress and degradation time.
- A time- and stress-dependent model was proposed for predicting the MRC of HFWC-MSW. The calculated results were in good agreement with the data measured from the pre-treatment container of the Laogang incineration plant. The strategy of combining the degradation-enhancing measures with stress-increasing measures is recommended in the rapid dewatering of an HFWC-MSW pile.