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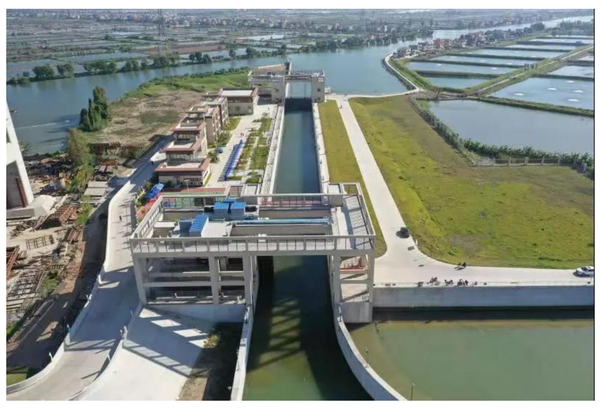
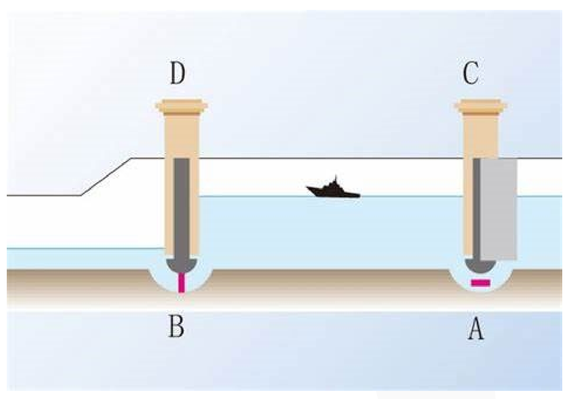
Investigation on Deterioration Behaviors of Ship Lock Concrete under Water Level Fluctuation of Inland River

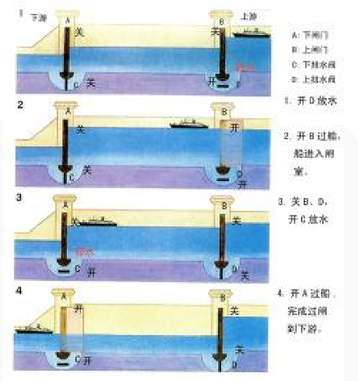
HAN Xuesong, XU Zhengfei, QIAN Wenxun, XU Fei, GE Jinyu

Objectives

The main deterioration factors of ship lock concrete of inland river are collision with ships and carbonization by CO2. The existing lock concrete is mostly designed according to the period of 50 years, the strength grade is low and the carbonation resistance is limited. There are also multiple effects of external wear and impact and environmental impact, which have significant performance damage, during the operation period.







Methods

The method of alternate damage of abrasion and carbonization cycle was used to simulate. The accelerated destruction of the concrete surface is consistent with the damage model of the navigable ship to the concrete surface of the lock. It can be equivalently simulated by the underwater method.

Method of test analysis:

- Underwater Steel-ball Method
- Accelerated Carbonation
- Mercury Intrusion Porosimetry
- Thermalgravimetric Analysis

Table 1 Circulation formulation of group 1

Cycle	Abrasion Time (h)	Carbonization Time (d)
1	7.2	2.8
2	14.4	5.6
…	…	…
10	72	28

Table 2 Circulation formulation of group 2

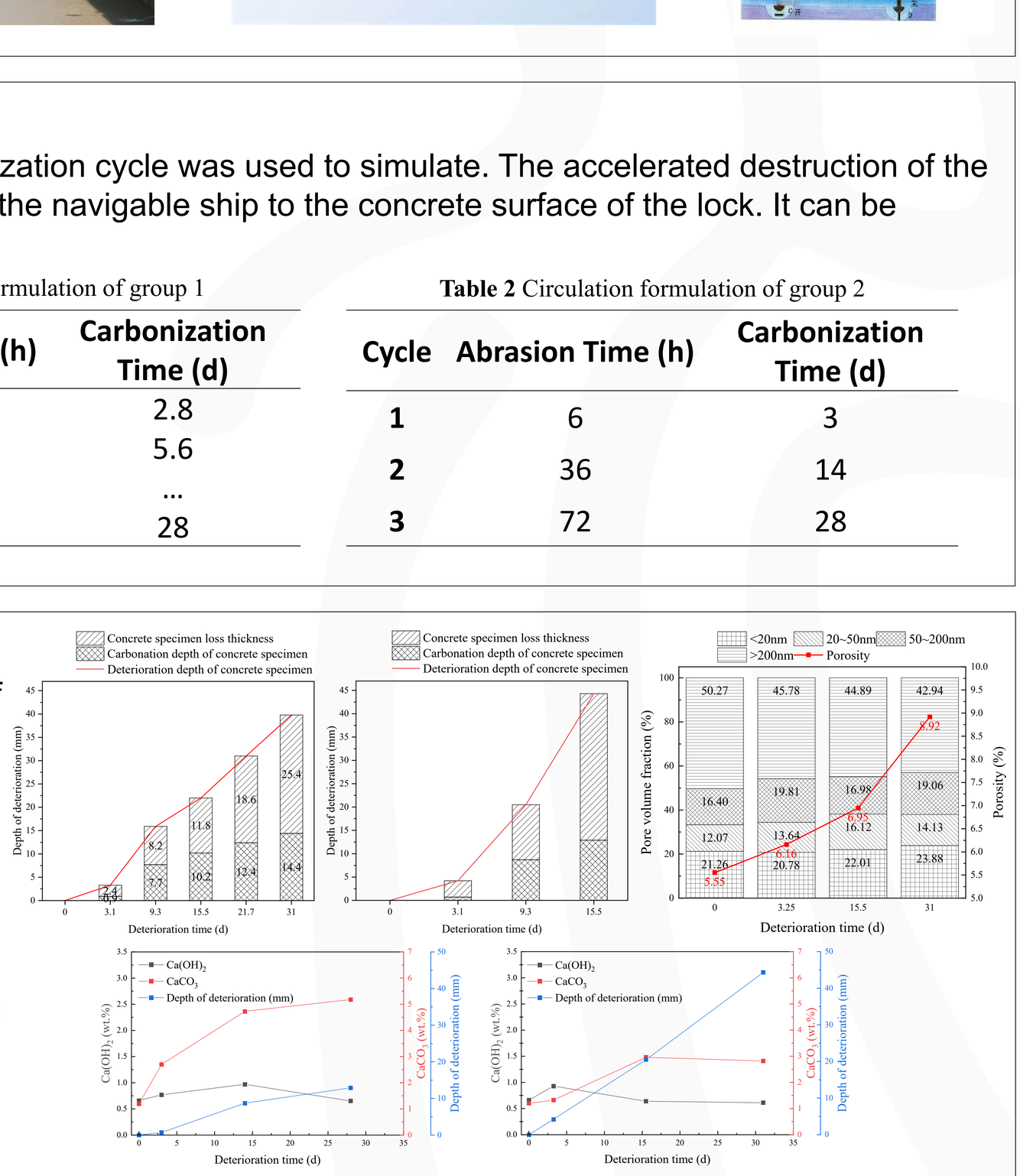
Cycle	Abrasion Time (h)	Carbonization Time (d)
1	6	3
2	36	14
3	72	28

Results

Depth of macro degradation: The deterioration depth of the concrete under the action of the abrasion and carbonation cycle has always maintained a rapid trend, and there is no sign of gentleness.

Damage of microscopic pore structure: The abrasion and carbonation cycle destroy the microscopic pore structure of concrete and increases the content of coarse pores in concrete.

Process of reaction product: The surface carbonization degree of concrete specimens is further increased and the carbonization shows the characteristics of high reaction rate and long maintenance time.



Conclusions

- The concrete deterioration speed is faster, and the deterioration depth is greater under the alternate deterioration of abrasion and carbonization cycle.
- Larger porosity corresponds to higher CO_2 diffusion rate, which means abrasion accelerates the diffusion of CO_2 inside the concrete.