

Calculation of Marine Environmental Carrying Capacity in Xiamen Bay: Numerical Model Approach

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Xiamen Bay is a semi-closed bay with an area of 230.14 km² and it is located on the west of Taiwan Strait. The discharges of pollutants into Xiamen Bay are increasing due to the development of economy, which has a negative impact on seawater quality of this area. This research on Marine Environmental Carrying Capacity (MECC) can provide useful information to guide the implementation of total pollutant control in Xiamen Bay. In this study, a linear summing method is adopted to calculate the MECC in Xiamen Bay. The pollutant transportation equation can be treated as a linear equation through the numerical model, i.e. variables are pollutant sources and the corresponding result is pollutant concentration under the prevailing hydrodynamic conditions, e.g. velocity, water volume and diffusion coefficient. So the concentration in the research domain can be acquired by linear sum of the concentration formed by each pollution source. Additionally, the concentration caused by each pollution source can be achieved by multiplying of the pollutant flux rate at each source with the concentration formed by a unit mass pollutant at the source, the latter can be defined as responding coefficient field.

A numerical model based on Princeton Ocean Model (POM) is used to simulate the hydrodynamic field in Xiamen Bay and lots of observed data, e.g. velocity, pollutant concentration, is used to verify the model. The responding coefficient of each point pollutant source and non-point source (NPS) is calculated by the model at first, and then the total concentration can be derived by the method mentioned above. With the responding coefficient field, a linear optimization method can be used to calculate the total MECC in Xiamen Bay with some constraint conditions, e.g. the total MECC shall be maximum, the pollutant concentration shall be less than the water quality standard and the pollutant flux rate shall not exceed the capacity of sewage treating plant.

Therefore, the MECC of the research domain can be acquired by evaluating the in situ concentration and the standard of water quality. In our research, Xiamen Bay is divided into five



zones and a 90% guarantee rate concentration in each zone is adopted as referential concentration, making the linear optimization method more efficient and practical based on the numerical modeling result. Finally, the result of the optimal MECC is adjusted according to the actual situation and relevant environment.