

Ecotoxicological effects of brine discharge on marine community by seawater desalination

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Received 31 November 2010; Accepted in revised form 28 March 2011

ABSTRACT

To determine ecotoxicological effects of brine discharge from the desalination plant and the potential tolerance impact associated with various marine communities, marine ecotoxicological assessment was carried out using four phytoplankton species (*Skeletonema costatum*, *Chlorella vulgaris*, *Tetraselmis suecica* and *Isochrysis galbana*) and macroalgae (*Ulva pertusa*) as primary producer, and two zooplankton species (neonate for rotifer *Brachionus plicatilis*, adult of harpacticoid copepod *Tigriopus japonicus*) and one demersal fish (olive flounder, *Paralichthys olivaceus*) as consumers. Values of 72 h EC₅₀ of population growth inhibition (PGI) for *S. costatum*, *C. vulgaris*, *T. suecica* and *I. galbana* were estimated as 55.1, 61.7, 56.9 and 42.2 ppt, respectively, and *I. galbana* was the most sensitive to brine. No significant differences in brine sensitivity were found in the ranges of 30.0–45.0 ppt for *S. costatum* and *T. suecica*, and less than 40.0 ppt for *I. galbana*. Mortality rates of *B. plicatilis* neonate and adult of *T. japonicus* revealed that brine less than 60.0 ppt caused <50% mortality and over 65.0 ppt showed >50% mortality for the two species in terms of acute toxicity. 24 h LC₅₀ and LOEC value of rotifer neonate (68.1 ppt and 55.0 ppt, respectively) were higher than those of *T. japonicus* (63.6 ppt and 40.0 ppt, respectively) for 96 h test periods. Spoluration rate of green algae *U. pertusa* sharply decreased from 60.0 ppt and 0% between 65.0 and 80.0 ppt with a 96 h EC50 value of 53.3 ppt. Survival of olive flounder fry *P. olivaceus* significantly decreased with the increase of brine concentration and the 96 h LC₅₀ value was estimated as 48.6 ppt, lower than green algae, but NOEC (40.0 ppt) of olive flounder was not different from that of green algae. In general, 40 ppt of salinity seems to be a threshold concentration for acute toxicity of brine. Differences of brine effect on each test species has a connection with difference of eco-physiological characteristics such as tolerance of organism on brine, exposure times, and natural habitats of test species. Therefore, site-specific test strategy is highly recommendable to reflect the local ecosystems for the brine discharge and also site selection of desalination plants.

Keywords: Desalination; Brine; Acute toxicity; Phytoplankton; Macroalgae; Copepod; Rotifer; Olive flounder

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