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Introduction

Flocculants are charged polymers of varying molecular weights that are used in the treatment of wastewater to increase the efficiency of settling, filtration and clarification. They act by forming bridges between individual particles when segments of a polymer chain adsorb onto different particles forming aggregates which are large enough to settle out under gravity. It is assumed that the low molecular weight polymers produce greater toxicological and/or ecotoxicological effects than the high molecular weight members because of their higher solubility and mobility.

Cationic polymers function primarily as coagulants and adsorb to the surface of negatively charged particles thus neutralizing electrostatic surface charges. Anionic polymers function primarily by binding together suspended particles into higher molecular weight aggregates that more readily settle out of solution. These may enter the terrestrial environment if they are not degraded during treatment process, as part of sludge disposal and wastewater irrigation on land or the aquatic environment via runoff. The impact and availability to biota will vary depending on such factors as the polymer concentration, volume of wastewater, type of treatment, post-treatment degradation, and local conditions. Ecotoxicological testing for aquatic organisms was conducted on three commonly used polymers used in the winery wastewater treatment.



Methodology

- The following three polymers were selected for bioassays:
 1. Jetfloc HP3 Cationic Powder flocculant
 2. Zetag 7689 flocculant
 3. Zetag 7635 flocculant
- Test organisms selected were:
 1. Waterflea, *Ceriodaphnia dubia*
 2. Duckweed, *Spirodela* sp
 3. Tadpoles, Spotted-marsh frog, *Limnodynastes tasmaniensis*
 4. Midge, *Chironomus tepperi*
- The median effect/lethal concentration (EC50/LC50) was the concentration of the polymer that was estimated to be effective in producing mortality (in case of waterfleas and tadpoles), growth (for duckweed bioassay) in 50% of test organisms.



Waterflea



Tadpoles



Duckweed

Results

- Based on the preliminary investigation, current polymers used in the wineries can be classified as being moderately to highly toxic.
- Jetfloc HP3 Cationic Powder flocculant was more toxic than compared with the other two polymers tested under this investigation (Tables 1 and 2).
- Zetag 7689 flocculant and Zetag 7635 flocculant exhibited similar level of toxicity to all the organisms selected in this study.
- The order of sensitivity of different organisms to the polymers was: waterfleas > tadpoles > midges > duckweed

Table 1. Polymer toxicity to *Ceriodaphnia dubia*

Polymer	48-h LC50
Jetfloc HP3 Cationic Powder flocculant	0.72 mg/L
Zetag 7689 flocculant	1.40 mg/L
Zetag 7635 flocculant	1.20 mg/L

Table 2. Polymer toxicity to tadpoles of the spotted marsh frog, *Limnodynastes tasmaniensis*

Polymer	48-h LC50
Jetfloc HP3 Cationic Powder flocculant	22.08 mg/L
Zetag 7689 flocculant	26.57 mg/L
Zetag 7635 flocculant	48.47 mg/L

Conclusions

1. Currently, a large number of cationic polymers are available for use and there is lack of information on their toxicity. This study only investigated three polymers in terms of their toxicity. Risk ranking of all polymers used by the wine industry is urgently needed.
2. There is a lack of information available on the polymer toxicity to terrestrial organisms. It is important when land disposal of winery wastewater is a common practice.
3. Information on the fate and persistence of polymers in the aquatic and terrestrial environments is required for better management of their use in treating winery wastewater.

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