

# BioBullets Ltd

## Entry for the IChemE Water Award

Zebra mussels are freshwater molluscs (up to 4 cm long) native to the Caspian and Black Sea region, which have invaded North America and Europe. Uniquely for fresh water species, zebra mussels attach with byssus threads or 'beards' to hard substrates and are renowned as one of the world's biggest pests.

The water supply and power generation industries are vulnerable to zebra mussels blocking intake pipes for water works or cooling water systems. The US military estimated in 1994 that lost revenue due to zebra mussels was two to three billion dollars per year in the United States alone. Zebra mussels also displace and kill many native species.



## The Current Control Strategy

By far the most popular control strategy is chlorination. Mussels will close when water is chlorinated and can survive for three weeks in this state, so chlorination must be continuous for this period. Chlorine reacts with organic matter in water to produce carcinogens. For this reason chlorination is being phased out upstream of British water works, and is undesirable and expensive in any raw water system, especially where the treated water passes into the open environment.

## The BioBullet

Zebra mussels are filter feeders. Two siphons can be seen. The larger, inhalant siphon sucks water into the mussel. Food particles of 5 to 200 microns are filtered over the gills and waste water and any rejected particles expelled via the smaller, exhalant siphon.

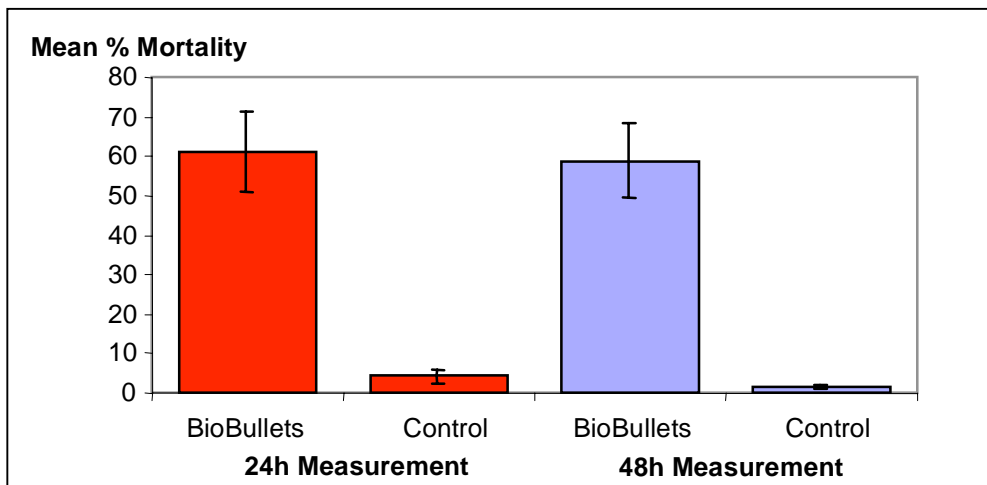
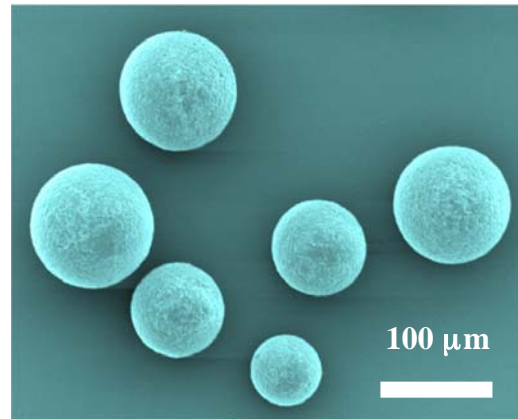
BioBullets exploit the efficiency of zebra mussels as filter feeders. The mussels will filter out and concentrate poisons if they are disguised as food particles, by encapsulation in a waterproof and nutritious coating.

Our product combines rapid killing of zebra mussels with minimum environmental damage. By using encapsulated particles instead of bulk molluscicides, the total quantity of toxin entering the water stream is greatly reduced.



Our product (see Electron Micrograph) is like a miniature, lethal Malteser!

In order to demonstrate the effectiveness of BioBullets, we have done two types of study. First we have used endoscopy to observe individual zebra mussels feeding on the BioBullets. Second we have done trials at an infested waterworks. Here we have specially constructed an array of pipes in which we have grown zebra mussels. We then treat the pipes with either our BioBullets or the same amount of toxin dissolved in the water. We test over 5000 mussels at once. The graph below shows that our product is massively more effective than the same amount of chemical used directly.



Our new technology offers the possibility of clearing invasive zebra mussels from the pipework of water works and power stations, economically and with greatly reduced environmental damage. In the last year we have developed a BioBullet, encapsulating a new toxin, and launched our product commercially with a full scale, and highly successful, trial at a UK waterworks. We also have tests underway with the US government, the Brazilian power industry, and a contract with shrimp farmers in Colombia. Our broad patent is also opening up opportunities to control pests that affect oil drilling and which carry disease.

Since winning the UK Research Council's Business Plan Competition in 2000, BioBullets has received two rounds of investment and is now valued at £1M.