

## **LEAD AND ALTERNATIVES TO LEAD IN AMMUNITION**

U. Qvarfort  
FOI NBC Defence, SE-901 82 Umeå, Sweden

### **ABSTRACT**

Lead has been used by humans for the past 6000 to 9000 years, and was one of the first metals humans learned to use. Five thousand years ago, it was discovered that small amounts of silver could be extracted as a by-product from lead, and production increased to a more extensive level. The introduction of silver coins about 2500 years ago also inspired an increase in production. Lead is mentioned in Egyptian writing already around 2000 B.C. and also appeared in various places in The Old Testament. There are descriptions of how lead was used in the hanging gardens of Babylon.

Concerning ammunition, lead has been used for a long time. One of the reasons for this is the metal's suitable attributes for manufacture, its great resistance, and high density. It has furthermore been easy to produce bullets with good ballistic properties, making it possible to hunt wildlife fast and effectively. The use of lead in ammunition has however been questioned and a Swedish regulation involving the prohibition of lead in ammunition will be established in the year 2008. One exception is shooting in environmentally-safe shooting ranges or similar activities.

As alternatives, several solutions have been proposed where other metals are used in the ammunition, often in different mixtures. In this presentation, a comparison between lead in ammunition and some other alternative materials including antimony, tin, nickel, tungsten, bismuth and iron (steel) is made. Several of these metals are not the only component in the bullets, but are often present as an alloy. This is necessary when a technical adaptation to ballistic requirements needs to be made, for example in terms of difference in density (mass per volume).

The starting point for this presentation will be to show the environmental properties of lead in comparison with alternative materials, regarding characteristics such as corrosion, transport in groundwater and surface water, availability in the environment, and human toxicology. In the report, the term corrosion is consistently used instead of the term weathering. Metals are the primary objects of study that will form corrosion products, which in turn might have a possible effect on the environment.

In the present report, activities are considered which are associated only with shooting and to some extent with hunting. Military shooting is only presented as an example. The same conditions are relevant with pellet shooting on marshes. In the presentation, general facts are shown about metal availability in the environment, how metals accumulate in plants, animals

and humans, and the environmental toxicological aspects of these metals. Furthermore, a survey and comparison is presented of the various metals that might be contained in ammunition.