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A Facile and Environmentally Friendly Disposal of Sodium and Potassium with Water

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Introduction

Experiments with sodium are dangerous because of its violent reaction with water and the formation of sodium peroxide on the surface after exposure to air for a longer period of time.

Figure 1. The photo shows the flower pot placed in a porcelain beaker. The flower pot is filled with dry sand and sodium before the water is added into the beaker.

The handling of sodium requires special care. Safety instructions are described in *Hazards in the Chemical Laboratory*.[1,2] Sodium is a common drying agent for many solvents such as ethers, tertiary amines, and hydrocarbons. After the drying process large amounts of sodium remain, and these residues have to be destroyed. The best method so far is the addition of 2-propanol to the sodium waste. Accidents occur when the water content of the alcohol is too high, when the addition of alcohol is too fast, and when alcohols of lower molecular weight are used.[3,4]

Results and Discussion

Herein an alternative, safe and less expensive method for the disposal of sodium or potassium is reported. A ceramic flower pot (Figure 1) is half filled with dry fine-grained sand. Sodium residues are placed on the dry sand. On top of the sodium a further layer of dry sand is placed. Finally the flower pot is placed in a large porcelain tray or dish. Water is added into the dish. After a few minutes water is drawn by capillary network into the sand. After 1−2 days all sodium is converted into NaOH and hydrogen. The sand is washed with water and, after drying, can be used again. As a control reaction, we used a glass beaker with a hole in the bottom and introduced a thermocouple close to the piece of sodium. We were not able to detect any increase in temperature during the hydrolysis. After the sodium was completely destroyed, a hole of the size of the sodium piece remained in the sand. The resulting NaOH attacks the SiO_2 to generate a small amount of sodium silicate that forms a skin on the grains of sand. The skin can be easily detected due to its white color.

The reaction of sodium with the water is very slow and inaudible.

In Figure 2 the hydrolyses of single pieces of sodium and potassium are shown. From the diagram it is quite obvious that the hydrolysis of potassium is, as expected, faster than that of sodium. Moreover, the figure shows quite clearly that the

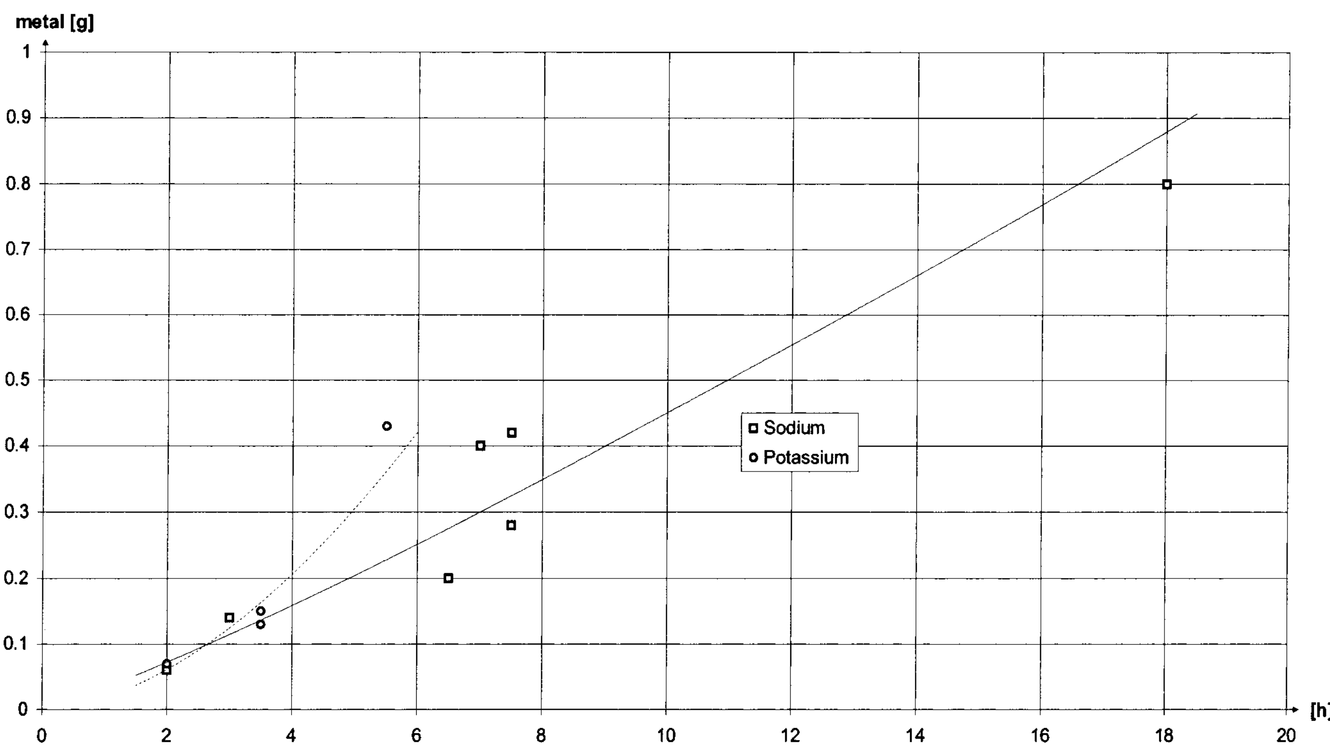

Figure 2. The diagram shows the time dependent hydrolysis of single pieces of sodium and potassium, respectively.

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hydrolysis occurs within a certain time range. This is due to the different surface quality of the metal pieces and for lack of determining the exact time when all the metal is consumed. Therefore in the Experimental Section the time given for the hydrolysis includes a safety factor.

In general, for the alcoholysis of 0.5 g of sodium, 100 mL of alcohol is needed. Therefore the expenses for treating sodium waste with water are drastically reduced, and environmentally more friendly products are generated.

WARNING! Potassium is often encrusted with KO_2. Explosions are observed when this material is cut with a knife or destroyed by alcohol. Therefore it is recommended to place potassium encrusted with KO_2 very gently on sand and to cover it very gently with sand. We were not able to perform the experiment due to the lack of the appropriate material.

Experimental Section

Disposal of Sodium Metal. The hole of a ceramic flower pot is covered with a layer of filter paper inside in order to avoid sand escaping through the hole. The flower pot, with a diameter of 10 cm, is half filled with dry fine-grained sand (e.g., sand for brickwork). The sodium metal (approximately 0.5−0.8 g) is placed on the top of the dry sand with tweezers. Finally the sodium is covered with a second layer of sand, till the flower pot is completely filled. The flower pot is placed in the porcelain tray, and water is added to the tray to raise the level of water to roughly 3 cm. After about 3 min the water has migrated into the sand and the reaction started. It is important that, during the reaction, there is always enough water in the tray. With 0.5 g of sodium, we observed that the reaction is complete within 24 h. After the reaction the sand is washed with water to remove the NaOH, and the sand is dried carefully to reuse it.

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