「南アフリカと日本における鉱山や河川の環境試料を用いる教材開発」

「DEVELOPMENT OF TEACHING MATERIALS FROM ENVIRONMENTAL SAMPLES OF MINES AND RIVERS IN SOUTH AFRICA AND JAPAN」

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1. INTRODUCTION

This study reports on the development of teaching materials by using samples from mines and their neighboring rivers. The indirect analysis of manganese in sediment and surface water was studied, and the procedures were simplified for high school learners.

For South African learners, studying about manganese could be useful because its compounds have extensive application in their curriculum. Moreover, since South Africa mines and processes manganese, the activities from this study would provide learners with an opportunity to study chemistry concepts using known and readily available resources.

A site in Kamiyama town, Japan, was chosen for this study. It resembles certain places in South Africa, in that the river passes close to an old copper mine. Samples were collected from three sampling sites, the Fish site (up-stream), the Mine site (adjacent to a mine slag) and the Blue concrete site (further down stream).

Analysis of samples collected from the Crocodile river, South Africa, was not conclusive and results were therefore not included in this report.

In this study, an indirect analysis of manganese was explored. Here, manganese was oxidized, using potassium periodate in a hot acid solution, to the violet permanganate complex. The equivalent amount of manganese was determined from photometric analysis of the permanganate complex.

In the case of sediment, oxidation was preceded by extraction.

2. RESULTS AND DISCUSSION

2.1 THE ANALYSIS OF MANGANESE

Results show that the mine slag contains trace amounts of manganese, 0.084%. High concentration of manganese is found in sediment from the Mine site, 0.448%. Sediment from the Fish and Blue concrete sites contain, respectively, 0.042% and 0.164% of manganese.

All surface water samples showed very low concentrations of dissolved manganese, except for the Mine site where the concentration was found to be 0.13 ppm.

Manganese is introduced in the river through a colorless solution (with

6.41 ppm of dissolved manganese) leaching from the mine slag. However, on entering the river's surface water, the dissolved manganese is converted to a residue that settles out of the water.

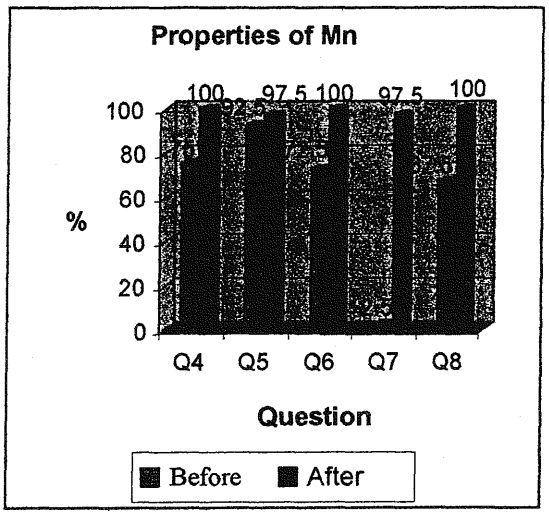
Most noticeable about this river is that the Fish site is inhabited by fish, something not observed in the other two sites down stream. This implies that fish cannot survive downstream because of chemical pollutants from the mine.

2.2 ACTIVITIES AT NARUTO HIGH SCHOOL

Hands-on activities were developed and tried to forty (40) grade 11 learners at Naruto high school. A questionnaire was distributed at the beginning and at the end of the activities.

Results suggest that learners had a good understanding of the properties of manganese, most notably the chemical symbol of the metal. The Figure below shows that 92.5% (37 learners), knew the symbol of manganese as Mn (Q5), but only 75% (30 learners) could write the name in Japanese (Q4). Results improved to 100% for the later and 97.5% for the former. As for Q6 and Q8, respectively, learners correctly classified manganese as solid, 72.5% (29 learners), and as metallic, 67.5% (27 learners). In both cases the results improved to 100%.

Q7, the colour of metallic manganese, was the most challenging question for the learners. For this question, only 1 learner (2.5%), wrote the answer as grey. This suggests that, although learners knew about manganese, they never had the opportunity to see the real substance.



85% (34 learners) knew examples of manganese compounds, with MnO_2 and $KMnO_4$ dominating the responses. However, only 57.5% (23 learners) knew their uses, with dry cell dominating the responses.

3. CONCLUSION

Learners were able to determine the relative amount of manganese from the samples and establish the impact of the mine slag to the environment. This implies that attempts were made to learn science in a natural way and to link the laboratory science to the environment. The following are extracts from learners' worksheet:

I found that Mn has several oxidation numbers. Your lesson was very much exciting. It was my first time to see Mn. When I answered about the color of Mn, you said "may be grey", I was impressed. I want you to come and present another lesson again!

I think it (fish) can be used as an indicator because fishes do not live in the place where the concentration of MnO_4^- is high.