CONSTRUCTION OF HUNVEYOR-9 AND EXPERIMENTS WITH ITS MAGNETIC CARPET OBSERVING DUST MIXTURES AT EÖTVÖS HIGH SCHHOL, TATA, HUNGARY. I. Magyar[1], T. Varga[2], Sz. Bérczi[3], Hegyi[4], Gy. Hudoba[5], B. Almády[1], A. Badics[1], I. Bakonyi[1], M. Franko[1], A. Gyürky[1], M. Héricz[1], R. Ikonga[1], A. Németh[1], T. Pardy[1], T. N. Varga[1], Gy. Végh[1], [1]Eötvös József High School, H-2890 Tata, Tanoda tér 5. (mirene@freemail.hu), [2]VTPatent Kft. H-1111 Budapest, Bertalan L. u. 20. Hungary, [3]Eötvös University, Institute of Physics, Dept. Materials Physics. H-1117, Budapest, Pázmány P. s. 1/a. Hungary (bercziszani@ludens.elte.hu), [4]Pécs University, Dept. Informatics and G. Technology, H-7624 Pécs, Ifjúság u. 6. [5]Budapest Polytechnik, Regional Information and Education Center, H-6000, Székesfehérvár, Budai út, Hungary,

Introduction: We report about the construction of the ninth **H**ungarian **Un**iversity Sur**veyor** (Hunveyor-9) and its experiment with magnetic dust observation by carpet containing small discs of magnets at Tata, Eötvös József High School, Hungary.

Activities: Hunveyor-9 construction and the first experiment: The first educational minimal space probe model was constructed at the Eötvös University, in 1997 [1-7]. The first high school model was made at Pannonhalma and recently the Eötvös József High School began the program with the Hunveyor-9. It had been built with camera and telescopic arm instrumentation, and a rover and test field around were also developed. We carried out experiments too. The magnetic carpet was the sensor and the dust mixture of magnetic and nonmagnetic components were the media to be observed.

Frame: Our frame is a little bit larger and more simple than the earlier Hunveyors. We have frame from copper, with circular cross section of 18 mm in diameter (and 1.5 mm thickness of the tube wall). There was a disadvantage of our solution: we could not form collapsible legs and footpads, like on the earlier constructions, therefore our tetrahedral frame form seems rigid as compared to Surveyor, or the earlier Hunveyors.

Dispersing experiment with an inside patterned carpet and magnetic dust: The dispersing experiment with magnetic dust mixtures was planned using a magnetic carpet. Between two sheets magnetic discs or squares were fixed in a pattern and on the surface of the carpet the magnetic attraction causes adherence of the magnetic component of the dust. Magnetic adherence makes the pattern visible by coloring the surface of the sheet above the magnetic discs (Fig.1.).

Fig. 1. After dispersing the mixture on the magnetic carpet (here white sheet) the magnetic component of the dust was adhered above the magnetic squares.

Similar experiment was carried out on Mars Pathfinder [8-10]. We imagined a Martian environment where the wind transports dust particles and the magnetic ones are trapped by the small magnetic discs which were sewed into the carpet.

Changing parameters in the dispersing experiment: There were two changing parameters: the mixing ratio between iron and sand, and the slope of the carpet.

Earlier we prepared 4 type of mixtures of sand and iron-filings. A. was the mixture of 1 weight percent of iron-filings and 99 % of sand. B. was the mixture of 5 weight percent of iron-filings and 95 % of sand. C. was the mixture of 10 weight percent of iron-filings and 90 % of sand and D. was correspondingly 20 weight percent of iron-filings and 80 % of sand.

In the experiments we used 3 different positions of the carpet depending on the conditions how it is sloped out from the Hunveyor-9 frame, when it was rolled out down to the soil: 1) on smooth flat carpet, 2) a small angle (gentle) aslope carpet, 3) a high angle aslope carpet.

Fig. 2. Experiment arrangement with early version of Hunveyor-9. This position of the carpet is in a gentle slope. The magnetic carpet here is a white sheet with patterned magnet squares fixed inside the carpet.

Fig. 3. Dispersing and adhering when the carpet is in position of a gentle slope.

The observations in the experiment:

Dispersing on smooth flat carpet: First we used the magnetic carpet as a flat plane (placed inside a basin). In the case of A and B mixtures the magnetic pattern became visible after shaking the basin. However, in the case of C and D mixtures, the pattern became visible even when the mixture was dispersed onto the flat carpet.

Dispersing onto a small angle aslope carpet:

Pattern appearance depends both on the person who disperses the mixture, and the type of the mixture. On the slope only the larger iron content dust gives adherence, while on the lower part of the carpet dust accumulates and covers the pattern. C and D mixtures give earlier (at smaller amounts of dust mixture dispersing) signs of adherence.

Dispersing onto a high angle aslope carpet:

Fig. 4. High angle slope adherence.

This case pattern appears only on the early phases of the dispersing at the flat parts (before the dust itself covers the magnetic particles), while mixtures of B, C and D adhere on the almost perpendicular parts in the case when dispersing person directly flush the dust onto the carpet.

Discussion and the student observations and questions during the experiment:

Students enjoyed the experiment and gradually recognized the role of the two parameters in determining the real mixing ratio of a real distant dust. Carrying out experiment with an unknown mixture the mixing ratio was determined by interpolating the produced pattern between the previous experimental cases.

The students proposed the following questions:

- We should try the case if the carpet does not roll down well.
- Almost perpendicular slope can not show the magnetic content, only in the case of very strong magnetic particle content. Therefore somehow we must stabilize the rolling down in a gentle slope position.
- Magnetic particles adhere and form small clusters, before they fall down from winds.
- If we place a solenoid with great number of coil and the magnetic particles can fly through the tube inside the solenoid then we can measure the magnetic particle content by measuring the induced electric current.

Summary:

The magnetic carpet experiments with construction of Hunveyor-9 and Husar-9 at the Eötvös József High School helped students to recognize the interesting phenomena of the planetary surface dust analysis. Next steps orient them to find measurements of other transported components of the wind-dust. Combined measurements will gradually make them recognize separation of elementary streams in a complex transported system.

Fig. 5. The Husar-9 rover between the rocks of the test terrain.

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