Other Properties (BET Surface Area, Conductivity, Organic Matter, and pH)

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Abstract

- Brunauer, Emmett, and Teller (BET) test were applied to dust samples in which samples (BET) surface area is highly related to the roundness of dust particles. The higher angularity and low roundness of the dust particles show a higher (BET) surface area. The roundness is also related to the particle size distribution and mineralogical composition.
- The electrical conductivity test relates very well with the chemical and physical properties of dust samples in the transmission of an electrical current.
- The organic matter content was measured using the ignition method and the pH of the samples was recorded.
- Maps of the distribution of high and low BET concentrations, electrical conductivity EC, organic matter content, pH.

Methods

BET Surface Area

The BET surface area is a specific measurement of the area of the dust particle surface. BET surface area resolute BET through gas physical adsorption of the dust particle surface by calculating the mass of adsorbed gas corresponding to a monomolecular layer on the particle surface. The gas physical adsorption results from weak van der Waals forces between the adsorbent surface area of the tested dust particles and the adsorbed nitrogen gaseous molecules. The determination is frequently carried out at the temperature of liquid nitrogen. The mass of gas adsorbed can be determined by either a volumetric or continuous flow process. The measurement of the BET surface area for dust particles was made using a COULTER-SA 3100 (Fig 8.1).

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Fig. 8.1 COULTER-3100 for measuring the BET surface area for dust particles

Electrical Conductivity

Electrical conductivity is a measurement that relates very well with the chemical and physical properties of dust samples. Electrical conductivity is the capability of a sample to transmit an electrical current, and it is normally expressed in units of deciSiemens per meter (dS/m). The electrical conductivity measurements can be expressed in milliSiemens per meter (mS/m) also, which is 100 times less than deciSiemens per meter.

pH

The dust samples were mixed in 125 ml of distilled water. The mixture was shaken in an electrical shaker for one hour and then left to settle for one hour. The resulting suspension was used for pH determination (Fig 8.2).

Fig. 8.2 Conductivity and pH meter used for dust samples

Organic Matter

The organic matter was measured using the ignition method, in which the dust sample was weighed, dried in an oven at 60 °C for 24 h, weighed again, and then washed in a muffle

furnace at 400 °C for four hours. The organic matter was calculated by using the difference of the initial weight and the final weight multiplied by 100/58. Organic matter % = organic carbon % $\times$ 11/58.

BET-Surface Area

The BET surface area is highly related to the roundness of dust particles. The higher angularity and low roundness of the dust particles reveal a higher BET surface area. The roundness is also related to the particle size distribution and mineralogical composition. Dust samples with smaller size fractions and lower quartz percentages have higher values of BET surface area. The dust samples in the northeastern part of Kuwait and near the coastal area have higher BET surface areas, with values of more than 12 m²/g. This result is attributed to geographical reasons, as those areas with high BET surface area are close to the Mesopotamian Floodplain and Al-Ahwar areas in Iraq, as dust coming from those areas is low in quartz and high in carbonates, feldspars, clay, and heavy minerals. Furthermore, the dust samples in summertime are expected to have a low BET surface area compared with winter (Fig. 8.3).

Areas with high BET concentration	Areas with low BET concentration
Abdulli Subiyah Jal Al Zur Khiran Sulaybiyah	Warba Island Khur Fawaris Shegaya Dibdibah Mutla

Conductivity

Electrical conductivity (EC) is a measurement of the dissolved material associated with or attached to dust samples, which relates to the ability of the material to conduct an electrical current. More salt or evaporated minerals, such as halite, gypsum, and anhydrite, cause higher values of EC. High conductivity is present on Bubiyan Island and the southern sector of Kuwait, as most sabkhas are present. Sabkhas contain salt minerals that cause an increase in conductivity. The areas extending from Jirashan in the north-west, near the Iraqi border, to northern Kuwait Bay displayed minimum values of conductivity readings (Fig. 8.4).

Areas with high conductivity concentration	Areas with low conductivity concentration
Bubiyan Island Failaka Island Kabd Um Qudayr Khur Fawaris	Warba Island Liyah Shegaya Jal Al Zur Mutla

Fig. 8.3 Surface area distribution of dust in Kuwait

Fig. 8.4 Conductivity area distribution for dust in Kuwait

Organic Matter

Organic matter is measured with reference to the total weight percentage for the dust samples. The values were restricted, from 1.38% to about 9%. The highest percentages of dust values containing organic matter within the dust samples were in the northeastern part of Kuwait and around farms. The presence of high organic matter percentages in dust samples collected in the northeastern parts of Kuwait is attributed to the type of dust, which mostly originates from the Mesopotamian Floodplain. Lower percentages were in the west and northwest of Kuwait. Compared with other dust

in the world, deposited dust in Kuwait can be classified as being rich in organic matter. Therefore, dust plays a major role in maintaining the ecological system in the region, and the organic matter in dust is essential, mainly to the marine environment (Fig. 8.5).

Areas with high organic matter concentration	Areas with low organic matter concentration
Bubiyan Island	Ubayriq
Dibdibah	Khur Fawaris
Um Niqa	Salmi
Failaka Island	Shegaya
Wafra Farms	Burqan

Fig. 8.5 Organic matter area distribution for dust in Kuwait

pH

The dust is more basic than acidic. The variation in pH values is from 7.4 to 8.1. The highest values are present in three areas, namely Huwamiliyah, Um Al-Qawatti, and Atrah, while the lowest are present in Jirashan, Shuaiba, Khur Fawaris, and Um Niqa.

These results might indicate that dust occurring in the northwest, from the Western Desert of Iraq, is more basic than the dust coming from other directions, mainly the

Mesopotamian Foodplain, Iran, and Saudi sides. The pH level might be related to humidity, as Saudi source areas of dust are more humid (Fig. 8.6).

Areas with high Ph concentration	Areas with low Ph concentration
Bubiyah Island	Shuaiba
Huwaymilyah	Khur Fawaris
Khiran	Ratqah
Atrah	Dibdibah
Um Al-Qawatti	Um Niqa

Fig. 8.6 Ph distribution for dust in Kuwait

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