Assessment of Rainwater and Run-off Quality at Agricultural and Water Resources Building, KISR, Kuwait: A Case Study

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Introduction

- In arid areas like Kuwait, with absence of natural water resources such as rivers, lakes and springs, the rainwater, run-off water should be utilized to the maximum extent.
- The urban run-off should be collected separately from the sewage and used directly for groundwater recharge or after the necessary treatment for domestic uses.
- Although the amount of rainfall is small, heavy run-off can create severe environmental problems for human, plants and soil displacement.
Rainfall in 16 Dec. 2004
Objective of the Study

- The main objective of the current study is to evaluate the quality of rainwater and run-off water after intense rainfall periods in urban areas of Kuwait.
Methodology

- The rainwater and run-off sampling were completed in three months from November 2005 to January 2006.
- The Agricultural and Water Resources Building (AWRB) at Kuwait Institute for Scientific Research (KISR) in the Shuwaikh area, Kuwait was selected to represent collection of run-off samples from a roof with area of $2845m^2$.
- Samples were collected during heavy rain fall and run-off periods.
- All samples were collected in sterilized glass bottles and without adding preservatives and were kept cool with ice bricks in the ice box, until these were delivered to the laboratory. Two to three liters of water samples were gathered from the site.
Agricultural and Water Resources Building at Kuwait Institute for Scientific Research
Water Sampling
Water Analysis
Methodology

- Water samples were analyzed for several parameters for the determination of both rainwater and run-off water quality.

- The water samples were analyzed for the following parameters: turbidity, Ca, Mg, Na, K, NH₃, SO₄, Cl, NO₃, NO₂, HCO₃, CO₃, F, Zn, Fe, Cu, Ni, V, Pb, TSS, TDS, total hardness, total organic carbon (TOC), chemical oxygen demand (COD), petroleum hydrocarbon (TPH), total coliform bacteria and fecal coliform bacteria.

- These parameters were analyzed according to Standard Methods for the Examination of Water and Wastewater (APHA, 1998).
The chemical, organic and bacterial analysis results for rainwater and run-off samples were compared with the World Health Organization guidelines for drinking water standards (WHO, 1984).
Salinity Concentrations of Water Samples

Rain Events (d)

TDS (mg/l)

- Rain
- Run-off
- WHO

Turbidity Concentrations of Water Samples

[Graph showing turbidity concentrations over time with specific dates and data points for Rain, Run-off, and WHO standards.]

Rain Events (d)

Turbidity (NTU)


- ▲ Rain
- ■ Run-off
- ••• WHO
Total Hardness Concentrations of Water Samples

Rain Events (d)


Total Hardness Concentrations (mg/l)

0  50  100  150  200  250  300  350  400

Rain
Run-off
WHO
Nitrate Concentrations of Water Samples

Nitrate Concentrations of Water Samples

Rain Events (d)

Nitrate (mg/l)


Rain

Run-off

WHO
TOC Concentrations of Water Samples

Rain Events (d)

TOC (mg/l)
Trace Elements Concentrations of Runoff Samples

Concentration (mg/l)

F-, Fe+2, Ni+2, Pb+2, Zn+
Total Coliform Bacteria in Water Samples
Rainwater Exploitation
Conclusions

- The rain water samples collected at KISR site indicated high levels of turbidity and total coliform bacteria whereas, the runoff samples including the first cycle of rain event on 13 November indicated high levels of TDS, total hardness, TOC, trace elements, total coliform and fecal coliform bacteria.

- These high values of turbidity and bacteria in the rainwater were due to the presence of dust and fine sand in the air, and on the surfaces of these particles, bacteria were adsorbed, and all dissolved in the rainwater and formed muddy rain.

- The high values of contaminants in the run-off samples were due to flushing of the accumulated sediments and dust on the roof of the KISR Building.
Conclusions

- The water quality parameters (turbidity and bacteria) for both the rainwater and runoff samples were above the recommended limits set by WHO drinking water standards.
- This water should not be used for drinking purpose unless it is treated for these parameters using techniques such as sand filter, activated adsorbed carbon and disinfection.
- However, this water can be used without treatment for other applications such as irrigation and washing.
Recommendations

- The Run-off samples should be collected and analyzed from all types of buildings as well as street run-off collecting points near stormwater manholes from several areas of Kuwait to assess their suitability for various uses.
- Meteorological station including rain gauge should be installed within the residential areas to estimate rainfall and monitor run-off quantity better.
- Design for a storage tank is needed to capture the roof run-off from different types of buildings.
- The treatment required for the run-off generated to make it usable for different uses should be investigated.
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Thank You