INVESTIGATIONS OF PIPE-BORNE WATER POLLUTION
IN BENIN CITY, NIGERIA

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(Received 23 November, 1979; Revised 22 February, 1980)

Abstract. Two important environmental parameters could be identified as being the main causes of pipe-borne water contamination in the City of Benin. These are the combined effects of rainfall and excessive construction work and, secondly, the lack or inadequacy of plumbing codes.

To study the combined effects of rainfall and excessive construction on the contamination of water, samples were tested for total coliform using the multiple-tube fermentation test. Sites were chosen to allow for the comparison of the coliform counts in areas of comparatively insignificant construction to areas of excessive public construction. Results show that in the areas of heavy public construction, the curves for both the rainfall and the coliform counts in the consumer lines were skewed in the same manner. The peak rainfall was in September (437.1 mm) which corresponds to peak coliform number in the consumer lines for both Zone A (62 coliforms/100 ml) and Zone B (60 coliforms/100 ml) for the same month.

When compared to the area of insignificant public construction as shown in Zone C, rainfall had little or no effect on the coliform counts either at the pumping station or in the consumer line. The maximum number of coliforms recorded for the consumer line was 5/100 ml during the month of June.

Results suggest that the high counts of coliforms in the Benin City water supply could be attributed primarily to the effects of construction which resulted in pipe breakage. During heavy rainfall and flooding, water under flood pressure enters the pipes through cracks, improperly tightened joints and damaged pipes.

The improper enforcement of plumbing codes or lack of such codes was also identified as another cause of the water contamination as shown in Zone D. A study of the effects of water pipes passing through septic tank drain fields also shows that such effluents served as another source of major contamination. The highest recorded number for coliforms for the pipe-borne water just before entering the septic tank drain field was 12/100 ml and after it passed through the field the number had gone up to 60/100 ml. Artificial contamination of the septic tank effluents to try to detect leaks in the water pipes passing through the absorption field was investigated. The bacterial contaminant could be recovered in the pipe-borne water and the quantity was skewed in the same manner as total rainfall between periods of sampling.

1. Introduction

The need for bacteriological examination of the water supply to determine its sanitary quality can hardly be over-emphasized. It is a vital and a dependable procedure for allaying fears of uncertainty and doubt regarding the potability of a given water supply. The origin of bacteriological examination of water dates back to the time when contaminated water was implicated in severe cases of disease outbreaks. To check further water-borne disease outbreaks, and to ensure that the water supply to a given community was safe, a number of authorities and organizations published their drinking water standards. These included the World Health Organization [6] and the United States Public Health Service [5].

These authorities suggested limits on the presence of coliform organisms and a requirement for minimum bacteriological sampling frequency during storage and distribution of water to ensure adequate operations, maintenance and surveillance of the
system. They also wanted to ensure a dependable supply of water including rules on site selection and construction of public water supply systems to protect them from sewage contamination and floods [2].

Benin City lies in the rain-forest zone of Bendel State of Nigeria. The central part of Benin City is very densely populated and is largely served by pit latrines. The outlying low density areas occupied by the middle-class are served by private sewage systems with water closets, septic tanks and drain fields. The central drainage is mostly open gutters, sometimes littered with tons of refuse and red soil from erosion. Because the city is expanding very rapidly, more people from the villages are being attracted to it in search of jobs, hence creating more public health problems.

The supply of water to the central part of the City which serves the majority of the population is extremely unpredictable. Because of the inadequacy of water, there is little or no concern for its bacteriologic quality. Preliminary survey work revealed that the quality was always very poor, hence there was urgent need for investigating the causes of the constant water pollution. The survey also indicated that there were three types of construction projects going on in Benin City. These include extensive road projects, underground drainage system to collect the sewage of the entire city and underground automatic telephone cable laying. These projects led to frequent water pipe breakages and potential water contamination. Additional information showed that there were no real plumbing codes designed to protect the health of the public and no uniformity of practice in plumbing. There is also a general tendency to employ poorly trained people at reduced rates who know little about the public health aspects of inadequate plumbing. The purpose of this work was to assess the extent of these factors on the high level bacterial contamination of Benin City pipe-borne water supply. It is not known whether an investigation has ever been done on the Benin City water supply as no records are available.

2. Materials and Methods

2.1. DESCRIPTION OF SAMPLING SITES

The sampling sites were divided into four main zones (A, B, C and D) with a view to gathering data on the effect of the construction and the lack of effectively enforced plumbing codes on the extent of pollution in Benin City pipe-borne water.

Zone A: This was made up of three sampling sites in an area of extensive road construction.

1. Ugbowo bore hole: This was examined to show the quality of water from the bore-hole just before treatment, and to enable comparison to be done with an open source (a river).

2. Ugbowo pumping station: This was examined to show the quality of the treated water before pumping into the consumer lines.

3. Ugbowo Campus, University of Benin Teaching Hospital (UBTH): This was an area of extensive road construction which resulted in frequent breaking of pipes. This was examined to show the quality of water in an area of extensive road construction.