



WATER TANK USAGE IN BUILDING SITES IN TURKEY: AN INTERNET-BASED STUDY WITH CIVIL ENGINEERS

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ABSTRACT

Introduction

In building sites, water is used for different purposes such as cleaning the used tools, meeting personal needs, making mortar etc. In cases of the building sites are far from the city center and/or water interruption is frequently experienced, water tank is used in the building sites to provide water.

Aim of the study

To define the properties of the water tank used in the building sites in Turkey and to evaluate water tank usage characteristics of the users.

Material and methods. We prepared 23-question survey and performed a survey study via internet with the civil engineers who are members of the internet-based forum site of the graduated from Department of Civil Engineering at Karadeniz Technical University and are still working as managers in building sites.

Results

Water in the tanks used in building sites is generally city water. Water in the tank is mostly used daily for personal needs, cleaning and fabrication. Most of the existing water tanks are made of polyethylene. Water tanks were cleaned most recently by an average of 5.4 ± 4.5 month (min.: 1 month- max.: 1 year) and cleaning is usually done with the facilities available in the building sites.

Conclusions

Our findings indicate that water tanks used in building sites are uncontrolled, and there is not any legislation for the control and inspection of the water tanks.

Key words: water tank, building construction, construction site, clean water

INTRODUCTION

In the construction sector, construction sites are designed to construct and finish in accordance with the specifications of the construction planned. There are some known examples of the construction sites such as roads, tunnels, dams, bridges, buildings, etc. Due to population growth in our country (Turkey), rising living standards and economic developments, there is an increasing need for living areas. To satisfy this requirement, building sites become importance to build these vital environments (1).

Since water is used in all economic sectors, it is also a necessary material in building sites (2). Water is commonly used in the building sites to fulfill some purposes such as suppressing dust, cleaning used tools and materials, making concrete and mortar, hardening the concrete, general cleaning of the area. Furthermore, the construction sites do not consist solely of areas where construction activities are carried out. They also include some places such as canteen, kitchen, bathroom, toilet, recreation areas, office etc. For this reason, water is also requiring to meet individual needs (3-5).

The need for water for the construction works and individual purposes in construction sites is also increasing because of rising building sites needed in Turkey. The amount of water required at the building site varies depending on the size of the site and the number of employees. Moreover, since more than one activity might be carried out at the same time in building sites, from the beginning of construction water needs are generally increasing when time goes on (5). Water such as city water, spring water, well water, etc. can be used to meet water needs in the construction sites. Water tanks can be installed to provide water for building sites, especially where construction sites are far from the center of the city and where water interruptions are frequent. However, water tanks installed on building sites are not included in the scope of legislation, and as uncontrolled and unsupervised. Due to this, there is uncertainty as to how the maintenance, repair and cleanliness of the water tanks will be done and by whom. These uncertainties may affect the quality of water in the water tank and may pose health risks due to human consumption. In addition, this situation can affect the stability and durability of the construction because water in tank might be also used in the construction process in the construction site.

In this study, it is aimed to define the properties of the water tank used in the building site areas in Turkey and to evaluate water tank usage characteristics of the users by internet.

MATERIALS AND METHODS

The study was to descriptive type and the sample was not selected. Civil engineers work as construction managers, i.e. site manager, project manager, site engineer, and they are most knowledgeable and authorized person about the water tanks in building sites. For this reason, as a target group, civil engineers who are members of the internet-based forum site of the graduated from Department of Civil Engineering at Karadeniz Technical University and are still working as managers in building sites have been taken into consideration. A questionnaire prepared by researchers was sent between 1-30 November 2016 by e-mail to this target group and it was

expected to reply to the e-mail by filling out it. Due to the lack of widespread use of the water tank and since the water needs met often at the building sites directly from the network system, 29 building site managers using the water tank agreed to participate in the survey by filling out the questionnaire form.

A questionnaire consisting of 23 questions prepared by researchers was used as data collection tool. On the first page of the questionnaire, it is stated that who made the investigation and its purpose, participation is based on volunteerism, and the information given will not to be used except for scientific purposes. In the first part of the questionnaire, participants' sociodemographic characteristics (age, gender and educational status) are questioned. On the other hand, in the second part, there are asked questions which can be summarized as below about the water tank used in the building site:

- Material on which the water tank is made and its volume
- Source of water in tank
- Whether color and odor change in water or not, and what they did if they were
- Usage purposes of water and frequency of using of water
- The thought about the chlorination of water and whether it is chlorinated or not
- Whether water was previously analyzed, whether any abnormality was detected if it was analyzed, and what they did if it was detected.
- Thoughts on how often the water tank should be cleaned
- How often they clean
- When was the last time tank was cleaned, who cleaned it
- Which materials were used for cleaning, and whether they read the label of the cleaning agent
- The state of approval of the Ministry of Health
- Thoughts on what they could lead to health problems if the water tank is not cleaned

Statistical analysis

Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS) version 23.0 for Windows. Descriptive statistics of evaluation results; number and percentage for categorical variables were presented. However, mean, standard deviation, minimum and maximum values were reported for continuous variables.

RESULTS

All of the 29 people working in building sites in different cities of our country (Turkey) and participating in our research are male; the mean age is 31.1 ± 7.4 (min: 23 - max: 46) years; 19 (65.5%) of 29 people have bachelor's degree; however, the other 10 (34.5%) have master of science degree. According to the information obtained from the participants, the maximum and minimum water intake capacities of tanks are 20 liters and 600 tons, respectively. The tanks used in the participants' building sites were cleaned lastly for before an average 5.4 ± 4.5 months (min. 1 month - max. 1 year). According to participants, the general characteristics of the water tanks in the sites and thoughts and behaviors related to their use, chlorination and cleaning are presented (Table 1 and 2).

Table 1. General characteristics of water tanks

	n	%
Water supply in water tank (n=29)		
City water	13	44.8
Well water	9	31.0
Spring water	5	17.2
Rain water	1	3.4
Coming with water tanker	1	3.4
Frequency of using the water tank (n=29)		
Every day	25	86.2
At different times when I need water	4	13.8
Objectives of using water*		
In manufacturing on building sites	20	69.0
Toilet	17	58.6
Bathroom	15	51.7
Dishwashing / laundry	14	48.3
Drinking water	8	27.6
Cooking	7	24.7
Material of the water tank (n=29)		
Plastic (polyethylene) water tank	17	58.6
Fiberglass (Polyester) water tank	4	13.8
Concrete tank (interior of it was tiled)	3	10.3
Galvanized / Sheet metal tank	2	6.9
I don't know	3	10.3
Color and odor variation in the water (n=29)		
No	13	44.8
Yes	8	27.6
I did not notice	8	27.6
Status of the water chlorination (n=29)		
No	16	55.2
Yes	13	44.8
Status of the water analysis (n=29)		
No	20	69.0
Yes	9	31.0
Status of detecting abnormally in analysis result (n=9)		
No	8	88.9
Yes	1	11.1

* marked more than one options

Table 2. Usage, chlorination and cleaning of water tanks

	n	%
When color and odor changes in water were determined*		
I cleared the water tank	4	50.0
I took a sample from water and was analyzed it	3	37.5
I continued to use the water tank except for drinking water	2	25.0
I continued to use the water tank	1	12.5
I applied to the health officer	1	12.5
I used water purifier	1	12.5
When there was an abnormality in the analysis results (n=1)		
Chlorination of water in the tank was made	1	100.0
Thoughts on the chlorination of water in the tank (n=29)		
Must be chlorinated from time to time	17	58.6
No chlorination required	8	27.6
Should be chlorinated every day	4	13.8
Thoughts about how often to clean water tanks (n=29)		
1 in 15 days	5	17.2
1 day in 1 month	9	31.0
1 day in 3 month	4	13.8
1 day in 6 month	6	20.7
1 day in 1 year	3	10.3
Should be cleared when water tank is dirty	2	6.9
How often the water tanks were cleaned (n=29)		
No	7	24.1
1 day in 1 month	5	17.2
1 day in 3 month	3	10.3
1 day in 6 month	3	10.3
1 day in 1 year	7	24.1
Water tank is cleaned when dirty	2	6.9
I don't know	2	6.9
Who cleans the water tank (n=23)		
Employee	15	68.2
Cleaning Company	3	13.6
Municipal authorities	1	4.5
I don't know	3	13.6
Substance used for cleaning the water tank*		
Mechanical cleaning with water and brush	11	50.0
Pressurized water jet	10	45.5
Chlorine solution	6	27.3
Bleach	3	13.6
Lime remover	3	13.6
Muriatic acid	2	9.1
Lime slip (calcium hypochlorite)	1	4.5
Sand	1	4.5
I don't know	4	18.2
Did you read cleaner's label? (n=11)		
No	5	45.5
Yes	6	54.5
Is the cleaning substance approved by the Ministry of Health? (n=11)		
Yes	4	36.4
I don't know	7	63.6

When the water tank was not cleaned*

Causes infectious diseases	22	82.8
Causes outbreaks	13	44.8
Causes deaths	9	31.0
Causes cancer	6	20.7
There is no harm in not being cleaned the water tank	1	3.4

* marked more than one options

DISCUSSIONS

In the building sites the quality of the water transferred to tanks is important; because water is used to supply the individual needs of employees and conduct works in construction site. According to our study, source of the water transferred to water tanks used in the building sites in Turkey is mostly city water (44.8%) and well water (31%). These waters are usually used every day in the buildings. But standards which identify water quality used in construction site and specify where water should be provided have not been developed. For this reason, use of water type may interact with materials which used in building construction and may have a negative impact on the stability of the construction. In addition, water usage as drinking-utility water may cause health problems in employees.

Water tanks should ideally be waterproof and leakproof, materials used in upholstery of tanks should not be affected by water abrasive features (6). In our study, it was found that 58.6% of the water tanks in the building sites were plastic tanks. Otherwise fiberglass, concrete and galvanized / sheet metal tanks can also be used. The structure of the water in the tank may be affected by the material of the tank is made and in particular the chemical composition of the water may change. This can lead to health problems for employees when used for individual purposes, and negative influence stability and specific structure of the concrete when used on construction site.

In our study, building site manager stated that the waters in the tanks can occur color and odor changes. It has also been stated that waters may not be analyzed and that analysis results sometimes may unproper for health. The waters used in the construction sites are important both for the health of the employees and people who will live there after the building constructions are completed as they are used many stages of constructions. Because of that, making the control and supervision at regular analysis of the waters will play an important role in protecting the health of employees and the community.

Due to the fact that water tanks in the construction sites are uncontrolled and unsupervised, there are also no establishments and things to be done aren't designated when there are problems with water tanks and waters in them. In our study it is observed that when waters have color and odor change and the abnormally analysis results, the site managers are looking for solution methods. These methods are such as cleaning the tank, taking samples from the water, chlorinating the water. Changes in the physical properties of waters may indicate microbiological and chemical contamination of the waters. Previous studies have shown that Legionella can cause health problems by forming a layer of biofilm in water tanks and their additions (7, 8). Changes in water structure may not always be noticeable by humans. For this reason physically, chemically and microbiologically controlling of the waters is essential.

Chlorination, one of the disinfection methods of waters, is used to control pathogenic microorganisms and the reasons of easily increasing of them in the water, and also oxidize organic substances which can cause bad smell and taste in the water (9). In our study, the percentage of the site managers think "water should be chlorinated every day" was found to be 13.8%. This situation indicates that site managers need to be informed about the importance of chlorination in terms of the control of undesirable substances in waters.

According to the guideline of chlorination, water tanks should be cleaned at least once a year (ideally every 6 months).

When the tanks are cleaned, the residues that accumulate on the surface should first be removed with a brush, then the entire surface should be brushed with chlorine solution and rinsed with plenty of water before evacuation.

After the cleaning process is completed, the entire system must be disinfected by superchlorination (9). In our study, it seems that the majority of the site managers think that the water tanks should be cleaned once a month. When questioned as to how often to clean the water tank cleaning of those who never in their construction (24.1%) and one clear of those years (24.1%) it shows that a high percentage. But it is also thought that the cleaning frequency of the water tanks can be affected by the installation time of the building site. For example, the reasons for not cleaning the water tanks in the building sites may be new beginning of the activity of the sites.

In our study, it has been seen that water tanks are usually cleaned by employees working in construction using different methods / materials. This suggests that the cleanliness of the water tanks is left to untrained people in this regard. Previous studies have shown that organic and inorganic materials can accumulate in waters of tanks and can cause various health problems in acute and chronic period (10, 11). For this reason, it is a positive finding that the majority of site managers state that infectious diseases and epidemics may occur when the water tanks are not cleared. But they need to be informed about especially other health problems which can occur when the water tanks are not cleared.

CONCLUSIONS

As a result, in our study, it was seen that the water depots used in building site areas were uncontrolled. In this sense, legislation should be set up for the control and supervision of the water tanks, which can be used for different purposes such as cleaning, bathroom, toilet, etc., in addition to the construction works in the sites. A mechanism of cooperation between health authorities and local governments should be established.

Competing Interests

All authors hereby have declared that no competing interests exist.

Authors Participations

All authors participated to design of questionnaire, writing the protocol, managing the analyses of the study, and writing all versions of the manuscript. VT, HBB, and TD participated in data collection. MT, CCK and KŞ performed the statistical analysis. All authors read and approved the final manuscript.

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