



Solid Waste Management in Saudi Arabia: An Environmental Analysis and Design of a Sustainable System

Fahad Alghamdi | 439017280

Suliman Almohsin | 439023842

Supervised by: Dr. Raouf Hassan

Abstract

- Solid waste constitutes a great danger to the environment and public health, especially if an integrated plan is not put in place to recycle and benefit from it and transform it. Solid waste is a great economic wealth that could generate millions if it was properly exploited, and factories were established to recycle and recycle them again. According to Vision 2030, the aim to reach to recycling ratio of solid waste to 90%. In 2022, the total amount of solid wastes in KSA was 50 million m3, and only 20% of it is recycled. The waste of palm trees is considered one of the most important sources of solid waste, the annual amount is equivalent to 700,000 tons.
- On the other hand, water availability is one of the most important challenges facing Saudi Arabia, so alternative solutions are being sought. Greywater reuse is one of the major alternative strategies that saves significant amounts of water. The project divided into two parts: experimental analysis and second part is a social study.
- Experimental study is carried out by using tree palm leaf (i.e., example of solid waste) as a filter media of greywater. Several samples of greywater (ablution and washing water) are collected from different locations in Riyadh. Three thickness filter media is used (i.e., 6,10,14 cm), moreover three curing ways are used; dry, tap water, distilled water cleaning. Several parameters are measured like pH, turbidity, conductivity, and total dissolved solid. The results show that the using of palm leaf as filter improves the properties of tested greywater samples by reducing the turbidity by 90%. The filter can filter up to 36 liters before it loses its ability to reduce turbidity.

Problem Statement



Solid waste (palm leaf)

Domestic wastewater



Solid waste (palm leaf)

KSA has 30 million palm trees, and each tree produce the annually 23 kilograms of waste. These wastes have a clear environmental impact, in addition to being a burden on farm owners, which necessitated the need to find alternatives to create transformational projects for these wastes.

Methodology

In this project there are two methods to reach the aim. The first one is to investigate awareness and level of acceptance for community of solid waste reuse. The second is to examine the effectiveness of the leaf palm filter, life span (capacity of filtration), ability reduce the turbidity, effect of the filter on TDS, and standards-checking requirements, compared with the American Code of Agriculture and toilet flushing.

Survey: A structured questionnaire is designed to assess the awareness and level of acceptance for community of solid waste reuse. Survey questionnaire was made available to the participants in one way: distributed on-line through social networking sites by using Google form. The survey questions were designed to ensure that the results are representative of the target population. As a result, they may be used with confidence in order to inform decisions.. A further measure has been taken to ensure that each participant has the opportunity to complete the questionnaire once. There was a total of 15 multi-choice questions prepared in both Arabic and English languages. The survey is being distributed in social media and data analysis is carried by using MS excel software. Several parameters are taken into account like, age, education, nationality and number of people living in the house.



Wastewater sample



Solid waste leaf palm



Media of the filter



Location of palm trees

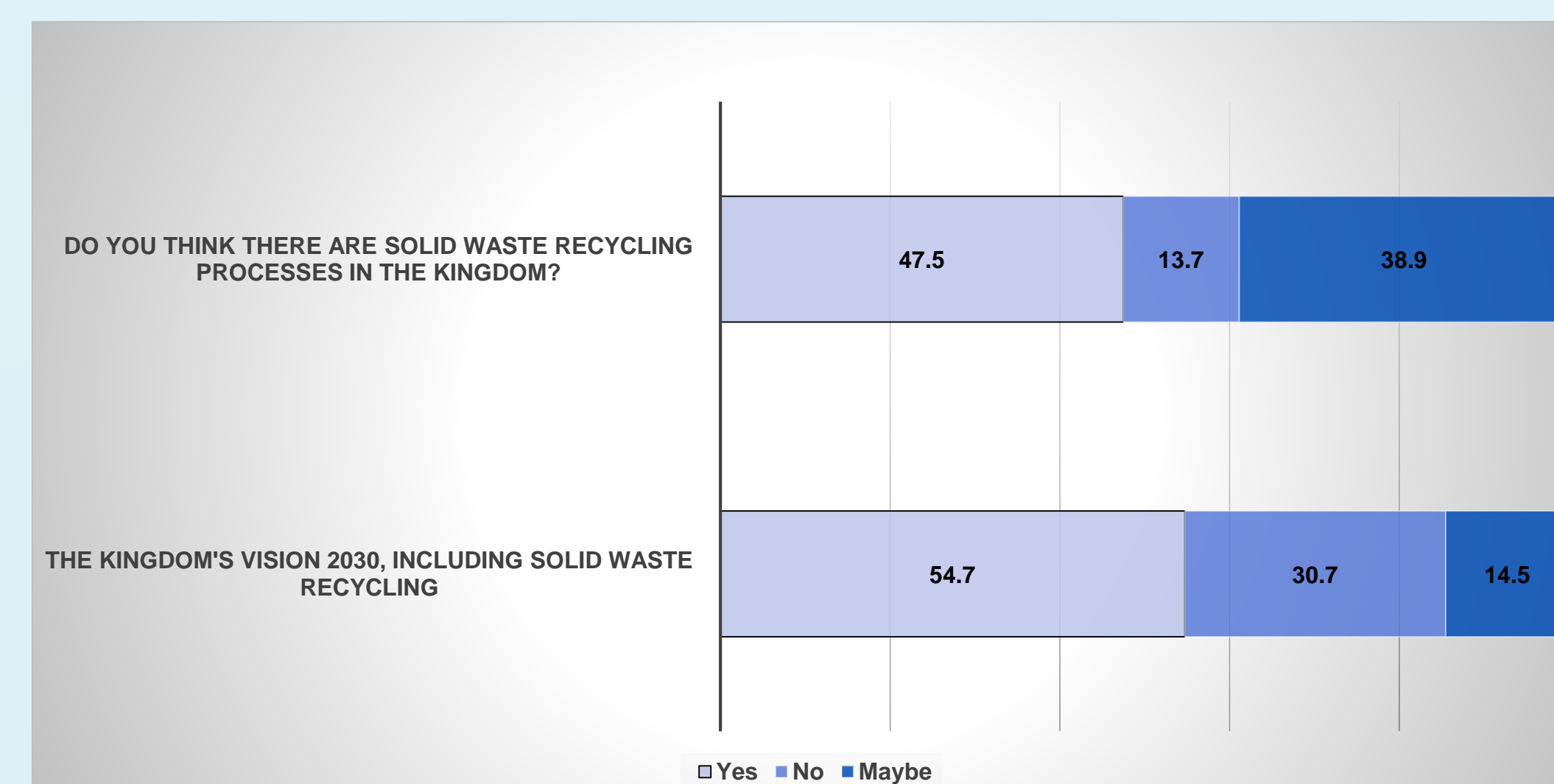


Figure 1.1 Awareness of solid waste recycling in the KSA.

Results and Discussion

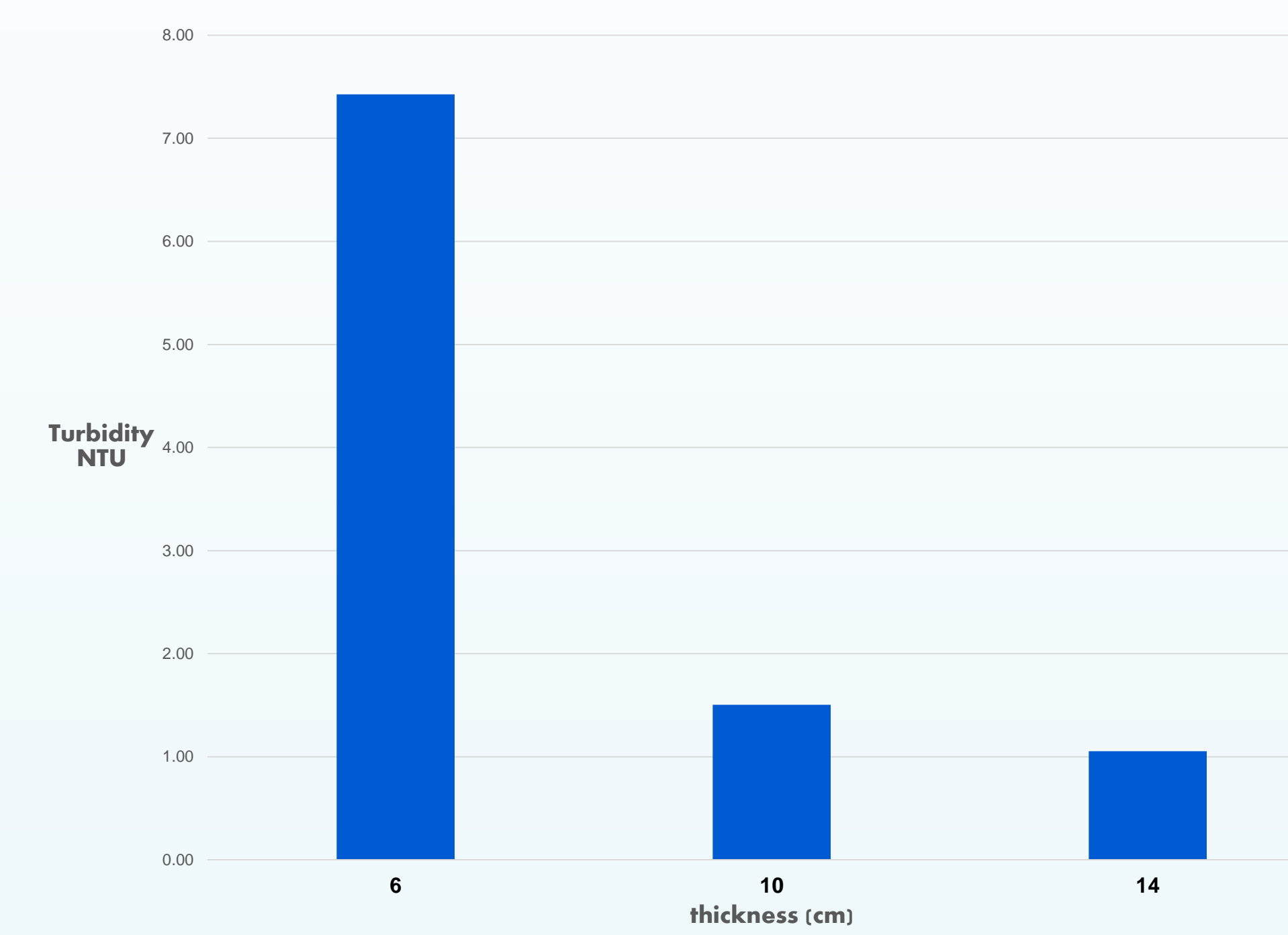


Figure 1.2 Relation of turbidity and thickness of filter

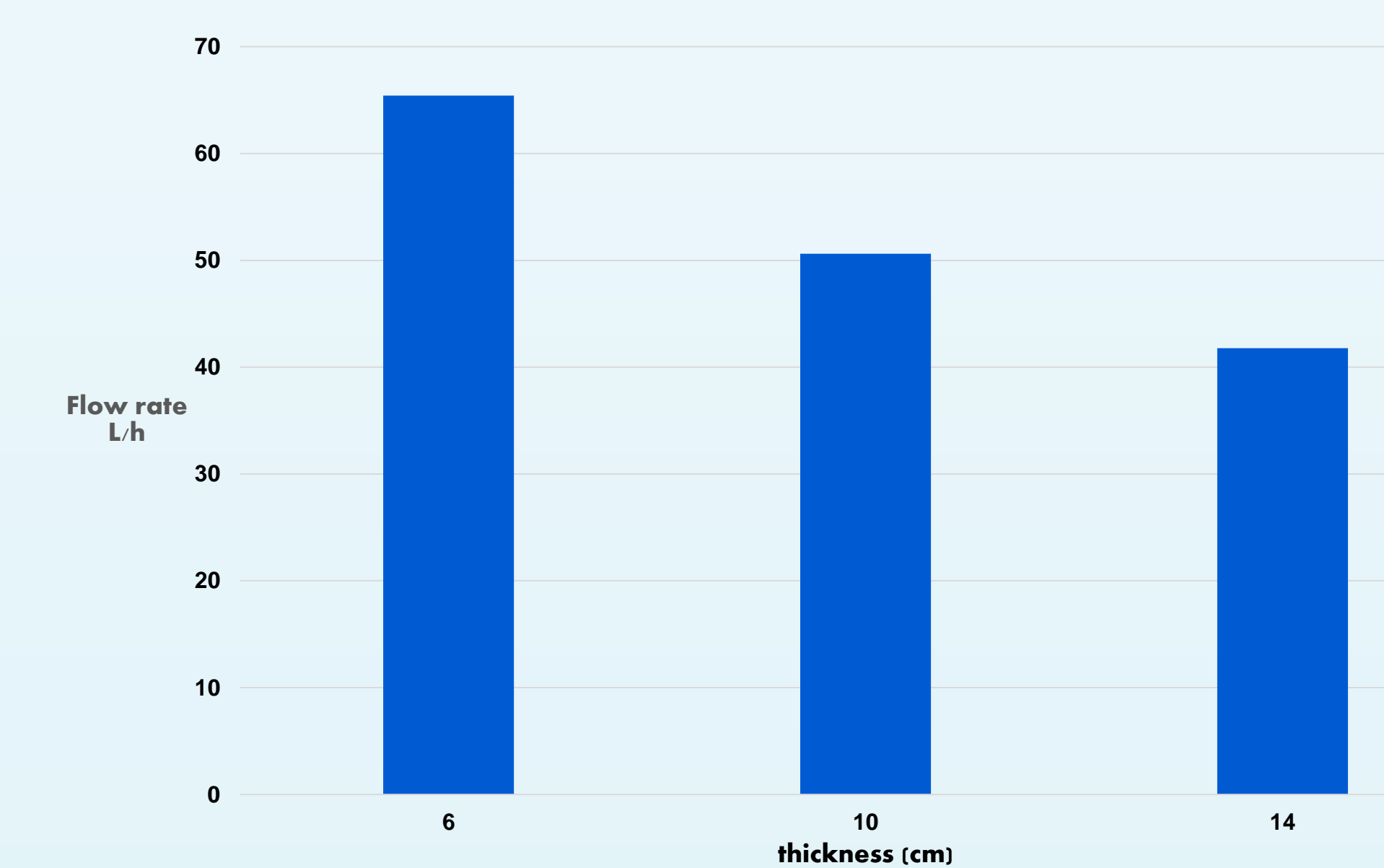


Figure 1.3 Flow rate for every thickness tested

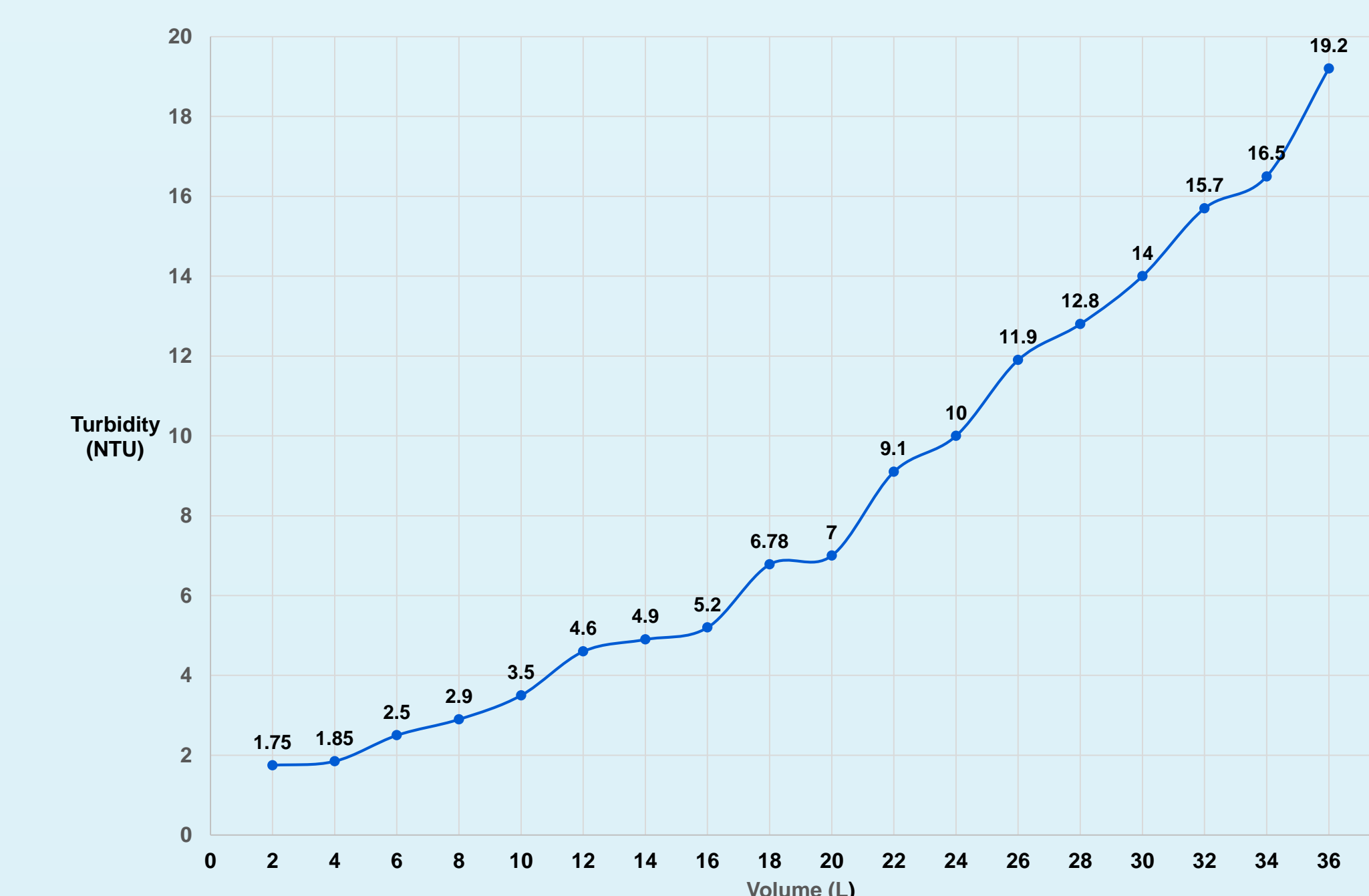


Figure 1.4 Turbidity vs accumulative volume L (capacity of filter)

As we see from the results in figure 1.2 the most effective media for the filter is 10 cm also media with 14 cm shows better performance but slightly less than the 10 cm.

The of capacity figure 1.4 the filter is 36 liters in wet condition with no sudden changes of the turbidity which gives us indication that the filter should be wet.

As shown in Figure 1.1, people who thinks there are solid waste recycling processes in the Kingdom are 281 individuals with a rate of 47.5% which is approximately half. People who said no are 81 with a rate of 13.7%. 230 have said maybe with a rate of 38.9%. Number of people who think that there will be solid waste recycling processes in the vision of Saudi Arabia are 324 at a rate of 54.7%. 182 individuals said no at a rate of 30.7%. And 86 said maybe with a rate of 14.5%.

Conclusion

- The filter's effectiveness is acceptable.
- In terms of ability to lower turbidity, a 10 cm thick filter is the most effective.
- The filter reduced the turbidity from 15.1 to 1.5 NTU in ablution sample.
- The filter reduced the turbidity from 359 to 180 NTU in washing sample.
- The filter is capable of 50.6 L/h.
- The maximum capacity was obtained after filtering 36 liters of sample in wet condition.
- The pH is unaffected by the filtering process; however, it depends on the sample.
- The leaf is Nonhomogeneous.
- The leaf should be cleaned by using tap water, distilled water at 40 C, or using Soxhlet machine.
- The Soxhlet cleaning process is excellent but highly expensive, the remaining TDS is only 1.4%.
- There were 592 respondents to the survey.
- The possibility of people using the recycled waste is high since 79.2% accepted it and the percent of people who rejected it was relatively low (2%).
- It has been demonstrated that, compared to other age groups, people 60 and older exhibited the highest level of knowledge about recycling solid waste.
- In comparison to other educational levels, an associate degree does not provide much awareness.

Recommendations

- Cleaning methods that are dry, wet and submerged are recommended; nevertheless, it is best to use an air blower and a water cartridge.
- The technique of cutting palm leafs should be improved.
- To prevent changes in the sample properties, it is preferable to have additional workers measure the properties as rapidly as possible.
- It is recommended to utilize smell removal products to get rid of the sample's offensive odor.