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Investigation on manhole sludge in Can Tho City

Pham Huu Ha Giang[1*], Le Gia Linh[1], Tran Duc Khanh[1], Vo Kim Ngan[1], Phan Thanh Ngoc Phuong[2], Nguyen My Phuong[3], Dien Thanh Binh[1], and Ho Quoc Phong[1]

[1]*College of Engineering, Can Tho University, Viet Nam*

[2]*School of Foreign Languages, Can Tho University, Viet Nam*

[3]*Transportation Department of Can Tho City, Viet Nam*

**Corresponding author (phhgiang@ctu.edu.vn)*

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ABSTRACT

During the rainy season, Can Tho city frequently faces severe flooding on its streets. In this study, the investigation is carried out on 30 streets and 10 canals nearby the streets in the center of Can Tho city. The results indicate that the surveyed manholes contain a lot of sludge with an average volume percent of 39.29%. In the food service areas, the average volume percent of sludge in manholes is found more than 70%. In the concentrated residential areas, the amount of sludge is less, but still at a relatively high rate (over 50%). In addition, the results show that the studied canals in the inner city are polluted due to waste directly from the drainage system. These issues have an effect on the drainage capacity of the roads. Some discussion on sand also shows that the sand shortage has reached an alarming level, which is the main factor leading to slow progress of some road projects. The sand reserves in the Mekong Delta region decrease sharply and the scarcity of sand causes sand prices to skyrocket, which is a difficult problem for this area. The development of mobile sludge treatment technology to produce a replacement material suitable for levelling and fertilizer purposes can be a potential topic for future research.

1. INTRODUCTION

The road drainage system is one of the basic systems of transportation infrastructure, playing a role in sustainable urban development. Currently, flooding caused by rain and high tides occurs regularly and is becoming increasingly serious in large urban areas (Quan, 2019). In Can Tho city, some drainage systems in the inner city are old, damaged, and have not been regularly maintained, affecting drainage capacity, leading to flooding in many places. At the same time, rain usually lasts from 30 minutes to 120 minutes with heavy rain combined with high tides around September, October and November. When it rains heavily, alleys do not have drainage systems, and sewers become clogged and cannot drain, causing flooding and making it difficult for people to travel and live (Do, 2020).

Besides, urban sludge is also a big problem that needs to be treated. According to statistics, the proportion of wastewater sludge volume in three regions of Vietnam is 36% in the North, 13% in the Central Region and 51% in the South (Phuong et al., 2021). Sludge in ponds, lakes and canals is natural mud or waste mud from the surrounding environment from human activities and industrial zones. Sewage sludge components include organic matter, minerals, and chemicals (Werther & Ogada,

1999), contain a variety of contaminants including heavy metals, drug residues, persistent organic pollutants, pathogens or microplastics (Smith et al., 2009). In addition, the scarcity of construction sand is also one of the problems hindering infrastructure development in the city (Ahmed et al., 2020).

Urban sludge and construction sand are challenges to the development of transportation infrastructure in big cities. Therefore, evaluating these issues is necessary for Can Tho city.

2. MATERIALS AND METHOD

2.1. Data collection

Sand reserves are compiled according to the general report of the Department of Minerals (Ministry of Natural Resources and Environment) in 2023 and sand prices are compiled from Prices posted on the website of Hau Giang Department of Construction (2023) for the period from 2020 to 2023.

2.2. Survey area

The purpose of the study is to evaluate the amount of sludge in residential and food service areas. Therefore, 30 streets in the center of Can Tho City (Figure 1) are investigated in this study, including National Highway (1): Nguyen Van Linh; Urban roads (13): Mau Than, Vo Van Kiet, Le Hong Phong, Le Loi, Ly Thuong Kiet, Tran Phu, Phan Dinh Phung, Nam Ky Khoi Nghia, Dong Van Cong, Ngo Thi Dam, Pham Ngu Lao, Xo Viet-Nghe Tinh, Ngo Quyen, Streets in residential areas (16): Cao Thang, 91B, Nguyen Binh, Nguyen De, Nguyen Tri Phuong, Nguyen Van Troi, Phan Chu Trinh, Street 14 Thoi Nhat, Street 20 - An Khanh Ward, Street 3 - Can Tho University of Medicine and Pharmacy, Tan Trao, Tran Quang Khai, Tu Xuong, Vo Thi Sau, Vo Truong Toan, Area 6 - An Khanh Ward. For each street, 20 manholes are surveyed in this study. In addition, 10 canals nearby the streets are also conducted in the study.

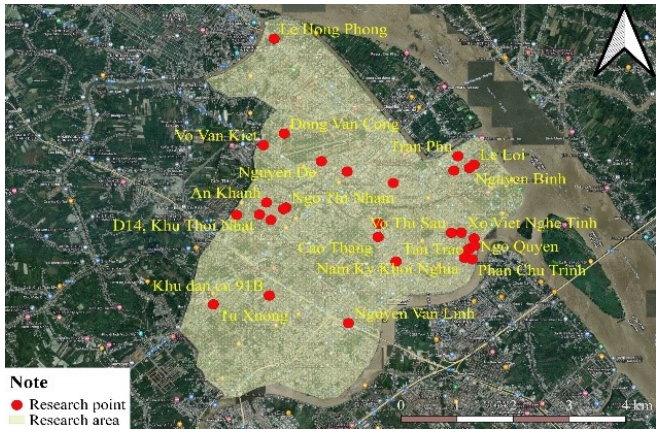


Figure 1. The survey area

2.3. Sludge thickness measurement

Some of the tools used in the study included crowbars, trowels, and rulers. The survey time is in October 2023. Figure 2 shows a sludge measurement inside a manhole on Tu Xuong street.

Figure 2. A measurement on Tu Xuong street

3. RESULTS AND DISCUSSION

3.1. Results of canal survey

The results show that some canals in the inner city of Can Tho are seriously polluted due to waste directly from the drainage system, sludge and stagnant waste for a long time (Figure 3). These results are described in Table 1. Some highly polluted canals such as Nguyen Tri Phuong, Mac Thien Tich, Alley 132 - 3/2 street. Nguyen Van Linh street, while Yet Kieu and the canal next to Nguyen Van Linh street are less polluted. The polluted areas are mostly located in concentrated residential areas due to the habit of throwing household waste. This is considered a main cause of environmental pollution.

Table 1. Results of canal survey in the center of Can Tho city

STT	Canal	Survey results
1	Next to Alley 51	Used plastic waste such as plastic boxes, Styrofoam containers, plastic bottles, plastic cups, mattresses, beds,... and organic waste filled in the canal.
2	Xeo Nhum	Mostly organic waste and domestic wastewater from households are discharged directly into canals, making the water polluted, turning black and bad smelling.
3	Yet Kieu	Plastic waste from shops, houses, and perennial plastic waste that does not decompose floats on the water surface.
4	Next to Nguyen Tri Phuong	A lot of plastic waste, animal carcasses, and an abundance of sludge and organic waste cause blockage in the flow.
5	Mac Thien Tich	Domestic wastewater from many restaurants and houses is discharged directly into the canal, making black water smelly.
6	Next to Alley 132 - 3/2 Street	Lots of leaves, dry branches, Styrofoam boxes, plastic bottles, plastic cups, plastic wrap and other organic waste.
7	Next to Tran Hoang Na Street	The canal water is polluted, oil and grease floating on the water surface.
8	Next to inter- alley 5 - 6, An Khanh Ward	Domestic wastewater, Styrofoam containers, animal carcasses, broken glass, etc.
9	Next to Tam Vu Street	Waste products from daily activities, foam boxes, plastic wrap, bottles, dry grass, animal and plant carcasses.
10	Next to Nguyen Van Linh Street	Most of it is organic waste like leaves and dry branches, causing a lot of sludges and blocking the flow.

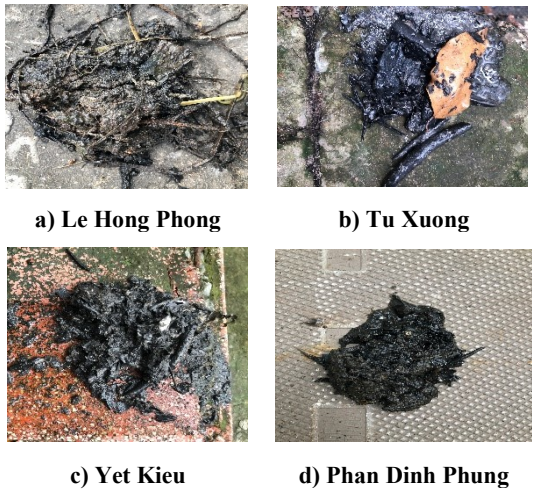
a) Nguyen Tri Phuong **b) Cai Khe**

c) Xeo Nhum **d) Yet Kieu**

Figure 3. Some canals in Can Tho

3.2. Results of sludge measurement

The survey team use a trowel to remove sludge from manholes of many roads in the center of Can Tho city (Figure 4).



a) Le Hong Phong **b) Tu Xuong**

c) Yet Kieu **d) Phan Dinh Phung**

Figure 4. Sludge in a manhole

Preliminary assessment results of sludge composition show that most manholes contain many types of impurities. From the naked eye, it can be seen that the majority of the ingredients in manhole sludge are domestic waste, leaves, dry branches, organic substances - food from restaurants.

Figure 5. A manhole on Phan Dinh Phung street

In this study, 20 manholes on each street are conducted. The average sludge thickness of 30 streets is calculated and summarized in Table 2. These results are summarized and shown in Figure 6.

The results show that all manholes have a large amount of sludge (Figure 5) with an average volume percent of 39.29%. The streets with food service in the center have very high amounts of sludge (Phan Chu Trinh street and Ly Thuong Kiet street account for 76.90% and 70.8%, respectively); The streets in concentrated residential areas are found at a relatively high amount of sludge (over 50%), especially areas near hospitals (Street No. 14, Thoi Nhat Residential Area, Street No. 3, Streets in Can Tho University of Medicine and Pharmacy Area); Main roads in urban areas account for over 40% (Nguyen Van Linh, Mau Than, Vo Van Kiet). This shows that the high amount of sludge comes from human daily activities. The large amount of sludge inside the manholes can reduce the drainage capacity of sewers, leading to flooding and difficulties in people's circulation.

Table 2. Results of sludge thickness

Route	Depth of manhole (cm)	Average value of sludge thickness (cm)	Route	Depth of manhole (cm)	Average value of sludge thickness (cm)
Phan Dinh Phung	60	14.55	Vo Truong Toan	160	53.40
Tan Trao	70	22.85	Le Hong Phong	130	48.65
Ly Thuong Kiet	70	49.55	Vo Van Kiet	160	94.60
Ngo Quyen	70	27.8	Dong Van Cong	180	43.95
Xo Viet Nghe Tinh	80	48.8	Nguyen De	200	102.30
Vo Thi Sau	75	28.55	Mau Than	200	99.55
Residential area 91B	160	21.75	Nguyen Van Linh	250	105.70
Zone 6, An Khanh ward	120	29.95	Nam Ky Khoi Nghia	160	77.85
Tu Xuong	150	49.55	Phan Chu Trinh	50	38.45
Nguyen Van Troi	160	31.5	Cao Thang	140	58.10
Le Loi	150	52.25	Ngo Thi Nham	200	51.10
Nguyen Binh	160	33.30	Nguyen Tri Phuong	220	108.95
Tran Quang Khai	180	27.40	D20, Zone 4, An Khanh ward	220	88.50
Tran Phu	150	36.10	D3, Can Tho University of Medicine and Pharmacy area	100	62.75
Pham Ngu Lao	100	26.90	D14, Thoi Nhut Residential area	200	113.00

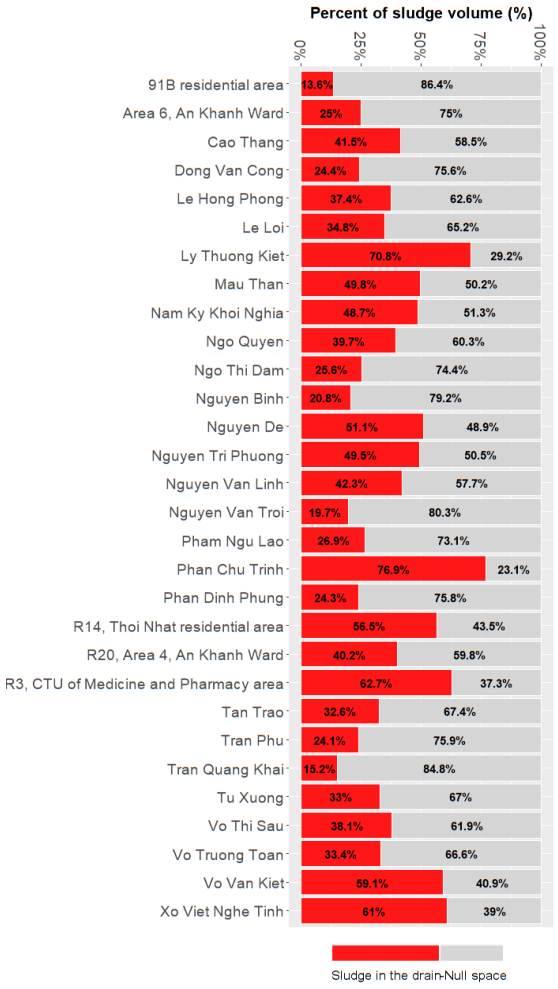


Figure 6. Volume percentage of sludge in the drain

4. DISCUSSION ON SAND RESERVES IN THE MEKONG DELTA REGION

There is a serious shortage of sand for filling, affecting the construction progress of many projects in the Mekong Delta region (Ngoc, 2023). According to the Ministry of Transport, the amount of sand for foundation is about 18.5 million m^3 short of the demand for the Can Tho - Hau Giang and Hau Giang - Ca Mau highway sections (Phung & Phu, 2023). According to statistics from the Department of Natural Resources and Environment of Can Tho city, the period 2021-2025 requires 34 million m^3 of sand for leveling, but the total sand reserve of the whole locality is only about 6.5 million m^3. The sand reserve licensed for exploitation in the Mekong Delta (2020-2029) of the whole region is 67.2 million m^3 (Figure 8). Meanwhile, in terms of transport infrastructure alone, 6 expressways deployed in the period 2022-2025 in the Mekong Delta need nearly 54 million m^3 of sand. The Can Tho-Ca Mau expressway project needs about 18.5 million m^3 of backfilling sand, but is only expected to have 1.1 million m^3, a shortage of more than 17 million m^3 (Tuyen, 2023). The amount of sand flowing from the upper Mekong into Vietnam through the Tien and Hau rivers is estimated at 2-4 million m^3. Meanwhile, the annual amount of sand exploited in the period 2017-2022 is from 35 to 55 million m^3. Sand reserves in the West are currently negative 42.3 million m^3 (Phong & Hang, 2023).

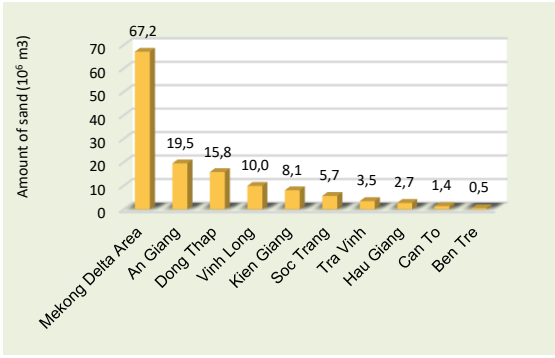


Figure 7. Sand resources licensed for exploitation in the Mekong Delta (2020-2029)

Sand scarcity has pushed up material prices in recent years. The aggregated results show that the sand price in Hau Giang province in 2023 is 245,000 VND/m^3, an increase of 37.6% compared to 2020, which was 178,000 VND/m^3 (Figure 8). Therefore, creating construction materials to replace filling sand is considered an urgent solution and can partly overcome the current shortage of sand sources.

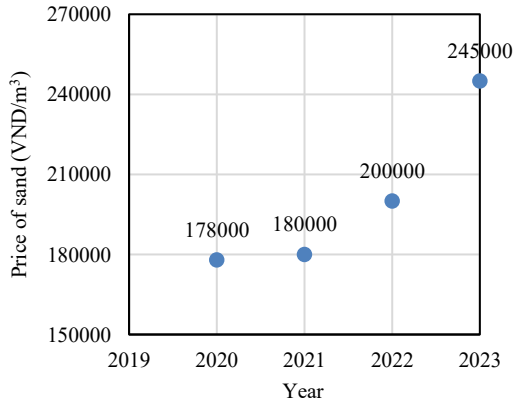


Figure 8. Price of construction sand in Hau Giang 2020 – 2023

(Source: https://soxaydung.haugiang.gov.vn/gia-vat-lieu-XD)

5. CONCLUSION

Based on the results of evaluating collected data and survey data on 30 streets and 10 canals in Can Tho, some conclusions are drawn as follows:

– The average amount of sludge found in the manholes is 39.29%. The streets with food service in the city center have a very high amount of sludge compared to streets with concentrated residential areas. On main streets, relatively high amounts of sludge are also found approximately 50% of the manhole volume. This can cause an influence on the drainage capacity of transportation infrastructure, especially in rainy season. Therefore, local authorities need to have a plan to inspect and monitor waste discharge processes from business and catering activities more strictly in the near future. Besides, pollution is found in most of the surveyed canals. If not handled promptly, it will affect human health.

– The aggregated results show that sand reserves decrease every year and are not enough for ongoing projects in the Mekong Delta region, causing a sharp rise in construction material prices. This is a challenge for the construction industry.

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