EVALUATION OF LEAD, ZINC, CADMIUM, CHROMIUM, COPPER AND NICKEL CONTENTS IN WASTE DUMP AND ROADSIDE SEDIMENTS WITHIN ONITSHA AND ENVIRON, SOUTHEAST NIGERIA.

Kaizer, A. N. and Ochei, N.
Department of Geology, Delta State University, Abraka, Nigeria
E-mail: abelkaizer@yahoo.com

ABSTRACT
Lead, zinc, cadmium, chromium, copper and nickel contents in waste dump and roadside sediments within Onitsha and environs were evaluated in the present study. Analysis of the magnitude of studied trace metals shows that their content in the waste dump were generally higher than those obtained from the roadside sediments. Analysis of the spatial distribution of trace metals in sediments around Onitsha shows that highest metal concentration of 0.19 mg/kg was found at the roadside near the dump site close to the Metallurgical Training Institute. High concentrations of metals in soils and waste dump sediments within the Onitsha metropolis are attributed to industrial and anthropogenic sources and are indicative of environmental pollution in Onitsha. It is therefore recommended that relevant authorities should step-up their waste treatment or disposal activities in order to minimize the hazards arising from indiscriminate dumping of wastes.

Keywords: Waste dump, Trace metal, soil, Onitsha, Nigeria

INTRODUCTION
The disposal of waste in developing countries is a problem that continues to grow with the development and growth of the population. Since the beginning of time, people have needed to find a way of disposing their waste. Sound waste disposal policies are not often practiced in many developing countries. In Nigeria, up till now, waste disposal often received the least attention; this is due to the ignorance of the effects of environmental pollution. For a country like Nigeria where 70% of its water resources comes from surface and groundwater, the importance of proper waste disposal methods to protect the ground and surface water needs not to be over-emphasized. With the emergence of more sophisticated high technologies, disposal of waste has since become problematic and hence the need for paradigm shift to protect the environment. According to Sridhar and Bammeke (1986) and, Ntekim et al (1993), contamination of soil by waste dumping can lead to poor growth and reduced crop yield, loss of wild life habitat, water pollution, soil erosion and desertification. The findings are also corroborated by the work of Kaizer (2007a), Kaizer (2007b), Kaizer and Adaikpoh (2007), and Kaizer and Osakwe (2008). Presence of trace metals in soil can occur naturally or by the accumulation of materials in which these metals are present. In little quantity, they are essential to maintain the metabolism of the human body but at higher concentrations can lead to poisoning.
Onitsha is one of the fastest growing industrial towns in Nigeria with high pollution potentials. This work is therefore carried out to determine trace metal contents of waste dumps and roadside soils within Onitsha and environs and the effect of the waste dump on the environment.

STUDY AREA
The study area falls between latitude 6^0 30^1N, 6^0 00N and longitude 7^0 00^1E, 6^0 30^1E, with an average elevation of 59 meters above sea level. It falls under the Anambra basin which is one of the sub-basins within the Benue trough complex in central south Nigeria (Reyment, 1965; Murat, 1970; Kogbe, 1975). Onitsha is a commercial town and is located close to the bank of the River Niger. It has one of the largest markets in Nigeria and has attracted industrial activities. The natural vegetation is a tropical dry or deciduous forest

which in its original form comprises tall trees with thick under growth and numerous climbers. The typical trees include silk, cotton, oil bean and Iroko which are deciduous shedding their leaves in the dry season. Because of the high population density most of the forests have been cleared for settlement and cultivation. What exists now is a secondary regrowth or a forest savannah mosaic, where the oil palm is predominantly together with selectively preserved economic trees. Although annual rainfall is high, ranging from 1,400mm in the north to 2,500mm in the south, it is concentrated in one season, with about four months of dryness, November to February. Generally, the climate of the area falls within the tropical climate with average temperature of about 34^0C, and a relative humidity of about 62.5% to 97.5%, while the prevalent wind direction is southwest with low wind speed average of about 1.80m/s. The River Niger forms the western boundary of the study area. During the dry season, excess rainfall is lost as surface run-off into these rivers, eroding surface sediments along with it. This increased water volume through precipitation causes overflow of the rivers from their banks. Few other ephemeral streams and creeks do exist but these usually dry up during the dry season. Due to the porous and permeable layer of sediments and associated rocks in the area, there are both vertical and horizontal movements of water. Though, groundwater moves relatively slowly through underground rock compared to the flow of water on the surface stream.

Three aquifer systems have been identified in the study area. These include, the upper unconfined, the middle semi -confined to confined, and the lower confined aquifer systems. The upper unconfined system extends throughout the area. Groundwater is encountered at shallower depths towards the west. The upper aquifer consists of permeable fine to medium grained sands overlain by laterites and/or red earth and underlain by impermeable shale, clay and semi-permeable sand clay. Average thickness of the upper unconfined aquifer varies from 21m - 24m in Onitsha. The semi-confined - confined aquifer system consist of thick fine to medium grained sands which sometimes grade even into clayey sands with depth range from about 30 meters - 32 meters. The lower confined aquifer system consists of fine to medium grained sands with some intercalations of thin clay bands. They are confined (above) mainly by shales, clays and sandy clays. The penetrated thickness varies from 15meters to 75 meters with an average thickness of about 45 meters. The depth varies from less than 90 meters around the study area. Assuming a mean effective poros-

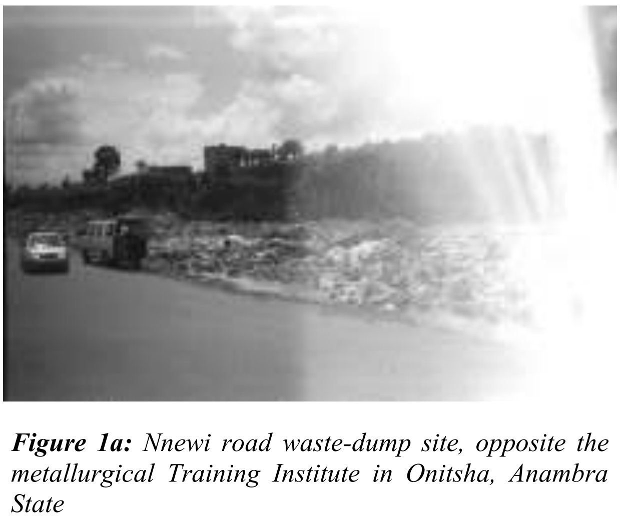

Figure 1a: *Nnewi road waste-dump site, opposite the metallurgical Training Institute in Onitsha, Anambra State*

Figure 1b: *Showing indiscriminate disposal of waste.*

METHODOLOGY

Soil samples (45) and 5 Leachate samples were collected from the waste dump and roadside sediments within Onitsha and environ while reference samples were collected from Obiaruku for the purpose of comparison. The samples were collected with the aid of a stainless steel hand corer from selected locations within the Onitsha town and dump site, and from the reference site at Obiaruku. At each location, samples were collected from 3-5 points and thoroughly mixed together to form a composite sample location. This was done to ascertain true representation and reproducibility of results. The samples were then stored in polythene bags and taken to the laboratory for analysis. Leachate samples were also collected from the waste dump in 1 litre polyethene bottles for analysis of their metal contents. Soil samples were air-dried, sieved, ground to pass 2mm mesh, then stored at 4ºC until it was required for laboratory analysis. In the laboratory, the soil samples were digested by measuring one gram of the sample and putting it in a Petri dish and distilled water added. The set up was then taken to a fume chamber and drops of 20ml HNO_3, 10ml HCl and 2ml HF added according to Abollino *et al.,* (2002) and Mihaly Cozmuta *et al.,* (2005). The digests were placed on a hot plate at about 130ºC and left for 2hours with constant stirring. The digests were transferred to a fume hood and Perchloric acid added to clear the cloudy nature of the solution. The digested material was then poured through a filter into a flat bottom flask and distilled water added to make the filtered solution up to 100ml. The solution was then analysed for trace metals using atomic absorption spectrometric method.

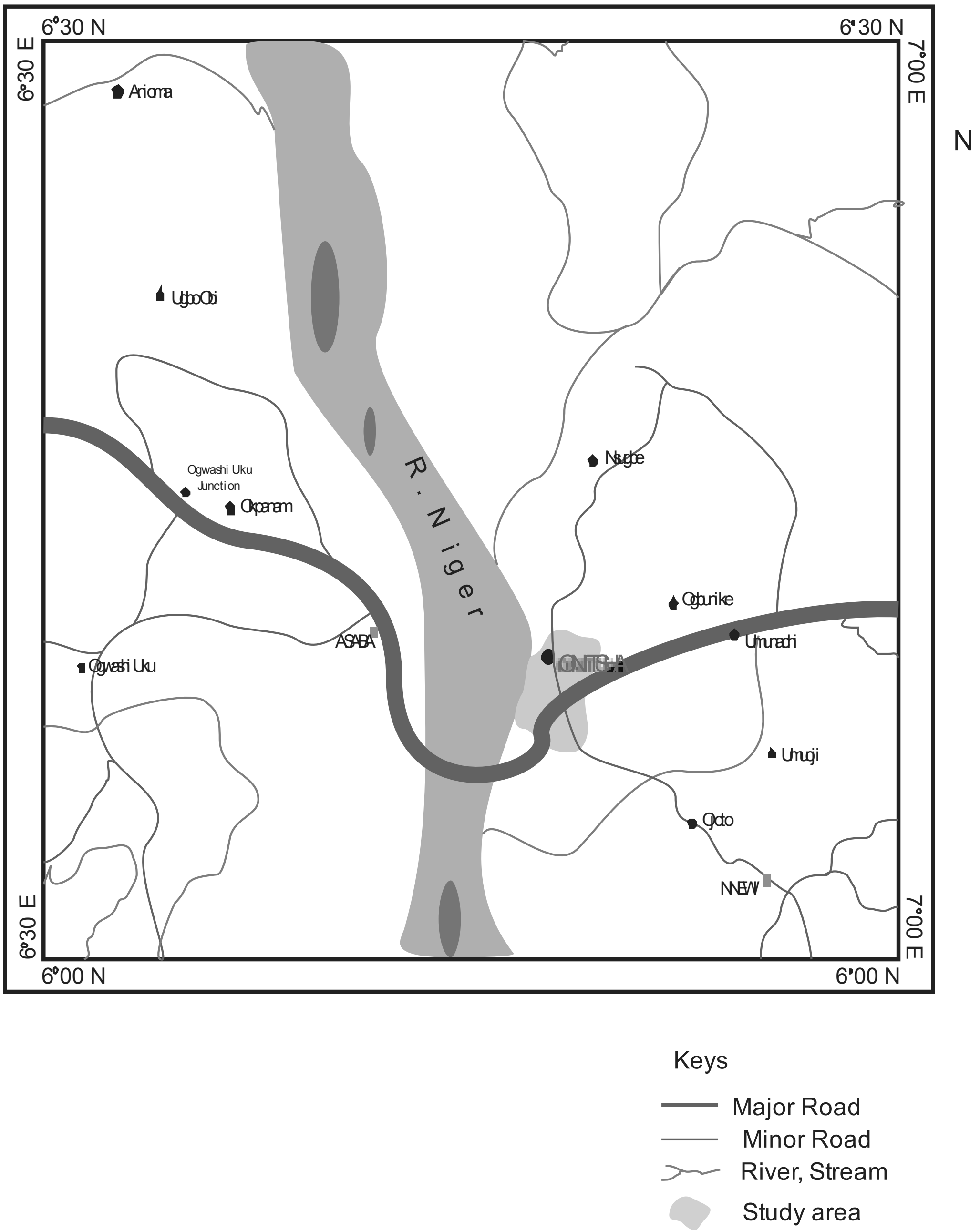

Fig 2: Showing map of the study area

RESULTS AND DISCUSSION

The results of chemical analysis of trace metal concentrations in the sampled soil and leachate within the study area are presented in table1.

Onitsha Dump Site.

The mean concentration of total trace metals in the waste dump site varied between 0.25mg/kg and 0.32mg/kg. Concentration of metals ranged between 0.001- 1.54smg/kg. It was observed that there were slight elevations in the mean concentration of metals in the waste dump compared to the roadside sediments. Concentrations of each metal analysed in the dump site did not exceed the WHO 2006 standard.

Leachate

The concentration of metal in the leachate samples ranged between <0.001- 0.38mg/kg with a mean total trace metal concentration of 0.15mg/kg. It was observed that the metal concentration in the leachate was higher than those of the dump sediments and roadside sediments.

Roadside Sediments

Total mean concentration of trace metals in the roadside sediment ONS-4, ONS-5, ONS-6 and ONS-7 were 0.19mg/kg, 0.15mg/kg, 0.10mg/kg and 0.17mg/kg respectively. Concentration of the various metals studied ranged between <0.001- 0.92mg/kg. The concentrations of metals were observed to be lower than that of the waste dump. Comparatively, mean concentration of total trace metals in Obiaruku (OBK-AM/DI) varied between 0.13mg/kg and 0.16mg/kg, ranging from <0.001- 0.74mg/kg.

Table1: Concentrations of trace metals in studied samples (mg/kg).

Sample Code	Lead	Zinc	Cadmium	Chromium	Copper	Nickel	Mean (Toal trace metal)
ONS-DS01	0.14	0.83	0.001	0.10	0.28	0.12	0.25
ONS-DS02	0.03	1.54	0.005	0.17	0.17	<0.01	0.32
ONS-DS03	0.12	1.27	0.001	0.05	0.13	<0.01	0.26
N = 12 (ONS MEAN)	0.09± 0.30	0.88± 0.60	0.0023± 0.50	0.1± 0.30	0.19± 0.20	0.04± 0.03	
ONS-D/H N= 3(leachate)	<0.01± 0.02	0.38±0.40	<0.001± 0.03	0.30± 0.07	0.07± 0.04	0.14±0.20	0.15
ONS-4	0.21	0.76	<0.001	0.17	N/A	N/A	0.19
ONS-5	0.04	0.82	<0.001	0.05	N/A	N/A	0.15
ONS-6	<0.01	0.54	<0.001	0.03	N/A	N/A	0.10
ONS-7	0.06	0.92	<0.001	0.06	N/A	N/A	0.17
N = 20 (ONS-MEAN)	0.08± 0.30	0.76± 0.33	<0.001± 0.35	0.08± 0.35	N/A	N/A	
OBK-AM/DI	0.05	0.74	<0.001	0.02	0.12	<0.01	0.16
OBK 2	0.04	0.62	<0.001	0.03	0.08	<0.01	0.13
N = 10 (OBK MEAN)	0.04± 0.29	0.68± 0.24	<0.001± 0.14	0.02± 0.09	0.10± 0.04	<0.01± 0.02	

SAMPLE CODES
ONS-DS01- Onitsha waste dumpsite location 1 ONS-DS02- Onitsha waste dumpsite location 2
ONS-DS03- Onitsha waste dumpsite location 3 ONS-D/H- waste dump leachate
ONS-4- roadside by Metallurgical Training Institute Onitsha ONS-5- Along Nnewi road
ONS-6- Upper Iweka Fly-over Bridge ONS-7- Onitsha- Owerri road (roadside)
OBK-AM/DI- Obiaruku-Amai road S2- OBIARUKU- Obiaruku to

TABLE 2: W.H.O SEDIMENT QUALITY CRITERIA (1978)

CHEMICAL PARAMETER	W.H.O. STANDARD (PPM)
Cadmium (Cd)	0.06
Chromium (Cr)	100.00
Nickel (Ni)	100.00
Copper (Cu)	36.00
Lead (Pb)	10.00
Zinc (Zn)	-

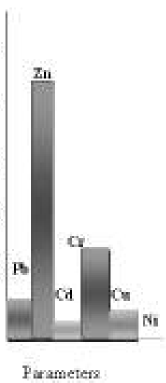

Figure 3: Concentration of trace Metal in Onitsha dumpsite L1

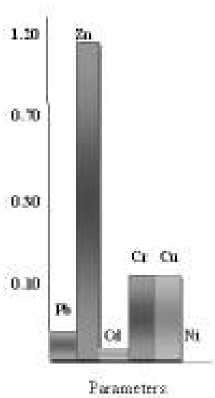

Figure 4: Concentration of trace Metal in Onitsha dumpsite L2

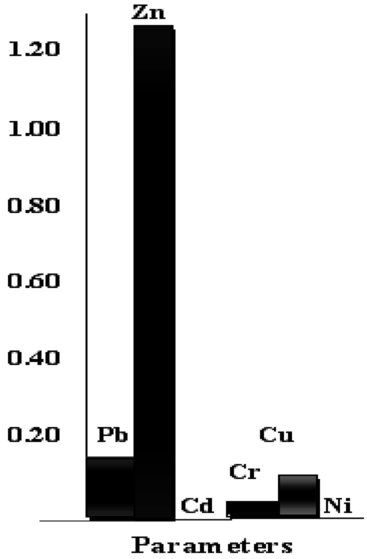

Figure 5: *Concentration of trace Metal in Onitsha dumpsite L3*

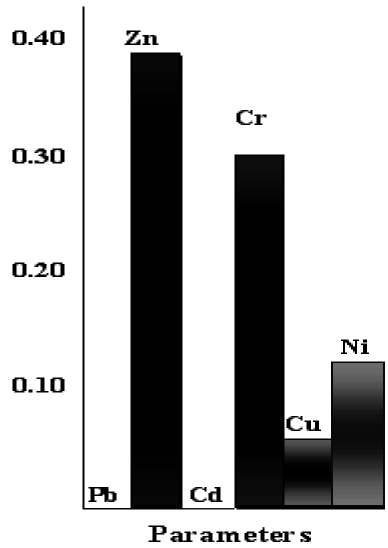

Figure 6: Concentration of trace Metal in Onitsha dumpsite Leachate

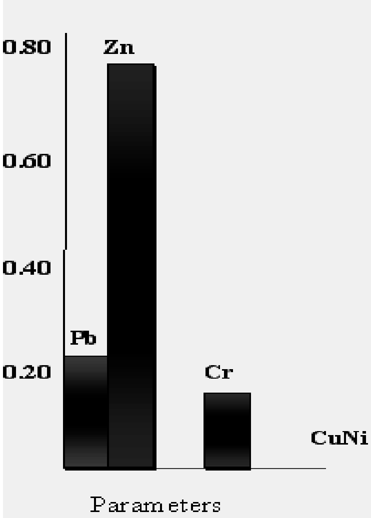

Figure 7: *Concentration of trace Metal in Central Onitsha*

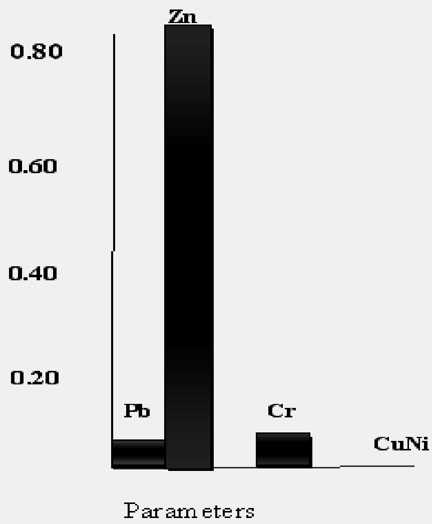

Figure 8*: Concentration of trace Metal in Nnewi road*

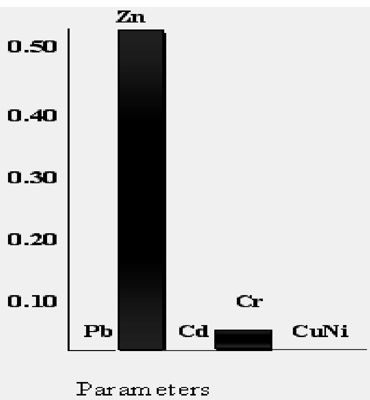

Figure 9: *Concentration of trace Metal in Iweka fly over bridge*

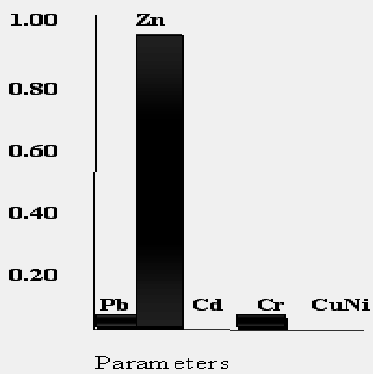

Figure 10: *Concentration of trace Metal in Onitsha – Owerri road*

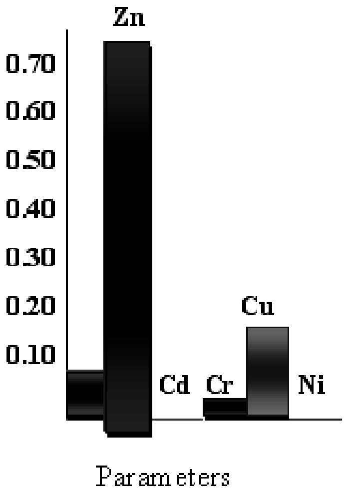

Figure 11: *Concentration of trace Metal in Obiaruku – Amai road*

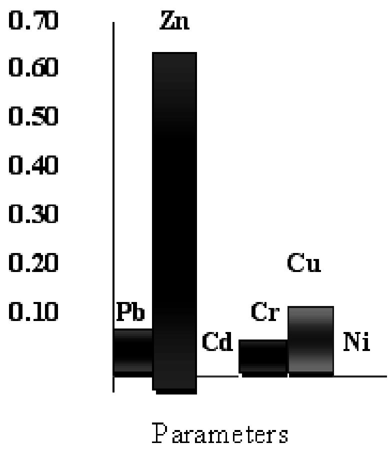

Figure 12: *Concentration of trace Metal in Obiaruku town*

Sources of Pollution

The waste dump consists of domestic and industrial materials such as used plastics, nylon bags, burnt materials, food cans, cloths, batteries, paper, expired paints, metal scraps e.t.c. Trace metals originating from the dump may move directly through leaching and seepages into groundwater aquifer which is about 10m at the base of the dump (deepest part) or migrate laterally through run-off processes and surface washout into the nearby Nkisi river and River Niger. However, regional distribution are increased through indiscriminate disposal sites in town such as the Upper Iweka fly-over bridge dump and the Onitsha-Owerri road (roadside) dump amongst others where mean concentration of metal contaminant was 0.10mg/kg and 0.17mg/kg respectively. Analysis of the magnitude concentration of studied trace metals shows that trace metal content in the waste dump were generally higher than those obtained from the roadside sediments (Table 1). In general, the highest concentration of metal contamination was found in the Onitsha waste dump site. Concentration followed the order ONS-DS02; 0.32mg/kg, ONS-DS03; 0.26mg/kg, ONS-DS01; 0.25mg/kg. Concentration of trace metals in the waste dump was higher than those from the roadside sediment by a magnitude difference of 0.22mg/kg. Analysis of the spatial distribution of trace metals in sediments around Onitsha shows that highest metal concentration of 0.19mg/kg was found at the roadside by the Metallurgical Training Institute where commercial and industrial activities are highest.

Effect Of The Waste Dump On The Environment.

The presence of the waste dump have adverse effect on the environment such as negative visual impact, generation of leachate and litters, attraction of vermin (rats and mice) and other household pests. It also affected the air quality through pungent odour it usually produce and surface and groundwater quality. In the study area where the upper unconfined aquifer system extends throughout the area, groundwater is encountered at shallower depths ranging from 21m to 24m. It consists of permeable fine to medium grained sands overlain by laterites and/or red earth. Hence, groundwater can be contaminated through infiltration of these metal contaminants from the dump site into the aquifer. Also, the disposal of waste near surface waters can also lead to contamination. Major rivers in the study area which can be affected by this contamination is the Nkisi River and River Niger which are about 1km from the dump site. They can also be contaminated through surface run-off whereby these wastes are washed into the rivers through flooding.

CONCLUSION AND RECOMMENDATIONS

The results obtained in this study revealed a large spread of metal contaminants in the surface soils. Metal concentrations in soils obtained around the waste dump site were higher than those obtained from the roadside sediments. The highest concentrations of contaminant were found at the Onitsha waste dump site (ONS-DS02).This high concentrations of metals in soils within the Onitsha metropolis are attributed to industrial and anthropogenic wastes and are indication of environmental pollution in Onitsha. It is therefore recommended that relevant authorities should step-up their waste treatment and disposal activities in order to minimize the hazard arising from indiscriminate dumping of wastes.

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