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A SURVEY OF SOIL FOR DETERMINATION OF CORROSION FACTORS. ON WATER PIPE WITHIN TEHRAN AREA

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ABSTRACT

Corrosion of water and gas pipes is not desirable from the view point of health, economy and nuisances. There are many factors in soil which attack the metal pipes for corrosion. (Steel, Cast, Iron and Like).

That is why the designer of metal pipes for conveyance of water and gas should be aware of these factors and pay utmost care in selection of pipes and protection facilities.

The results of research and surveys in different areas of the world indicate that there are certain main soil factors such as Resistivity of the soil, PH, Rodex, Potential, Sulfides, Moisture Content, Particle size and uniformity which affect the rate of corrosion. In this research the route of all main pipes within Tehran area is surveyed and mapped and in every 1 to 2 kilometer soil is sampled and analysed for moisture content, sulfides, TDS, PH, and soil resistivity which are presented in table 1 and 2.

Based on results, the soil of south and west side of Tehran is rather very corrosive to metals and the soil of north of Tehran comparatively has less corrosion effects.

1- INTRODUCTION

Due to increasing rate of application of metals for buildings, ships, planes and pipes for conveying water, oil and gases, the problems of corrosion of these metals due to environmental factors around it has attracted the attention of different concerned people.

Corrosion of water pipes, not only gives bad tastes to water unsafe for household uses. Besides, the end result of corrosion of pipes which is the development of holes and cavities, causes leakage and loss of water and in some cases the introduction of the germs of water-borne diseases into it. (1,10,11).

From the engineering point of view, corrosion of pipes, causes the reduction of carrying capacities and mechanical strength of pipes so that burst of pressure lines can be expected.

According to existing documents during 1950-1960 in Detroit, 790 cases of pipe leakage due to corrosion were reported.

Taking into consideration that repair of each leakage costs $300, corrosion can be considered as waste of money (6.8). Also industries are paying tremendous amount of money directely and indirectly for corrosion control of their metal works.

Generally speaking, all industrial institutions experience some kind and some degree of metal corrosion so it is not surprising to find that many companies allocate quite some budjet for protection of their metal works againt corrosion, for example, cost compensation of corrosion damages for water work installations in the U.S.A. is about 150 million Dollars annually.

This cost was 10 million Dollar during 1961-1971 for Sandiago and one million Dollar in 1054 for north Africa (4,7).

Corrosion also causes reduction in efficiency of many types of heat exchangers due to sedimentation of corroded parts; in booster pipes demanding more head to boost the same amount of water, so more power loss.

During the last two decades protection of buried water pipes has attracted the attention of concerned people and many projects were put into execution so that quite lots of experiences is now available (2,3,4); to-day, design of corrosion control systems is practiced with rather good accuracy.

Knowing that many parts of our country have corrosive soils, it is necessary that during design of water supply projects care being taken for selection of materials with due regard to corrosion action of soil around it and if necessary cathodic protection being incorporat ed with the project.

As the elements causing corrosion of pipes are within the soil

around the pipe so it is practically possible before installation of pipe these factors are studied and be determined. Due to lack of trained personnel and equipment, this phase of study is not practiced for rather small water supply projects, so if this soil study is done by research centers and universities and certain data sheets or maps are developed, the designer of pipe line can refer to these data sheets.

The purpose of this research was the appraisal of soil that affect the corrosion of metal pipes — there are certain factors which are affecting this rate and has come in different literatures (15). Among these factors are earth resistivity, PH, Sulfides, Particle size and its uniformity, Moisture content (Relative). Among the above-mentioned factos, resistivity, PH, sulfide moisture content and Rodexpotential are used for soil-test evaluation (15).

2- METHOD OF SURVEY:

The route of all main water pipe is studied and practically every 1-2 kilometer is studied as follows:

1- Soil of few centimeter below ground surface is sampled for analysis for determination of factors which are given in table of chemical analysis in table 2.

2- Soil resistivity is determined by Four-pin Vibroground Technique.

3- RESULTS AND DISCUSSION

First part of this investigation was determination of electrical resistivity of the soil within the boundary of Tehran.

The area covered was limited from north to Shemiran-Tadjrish square, south from Shahre-Rey square, west to Azadi-Square and east to Tehran-Pars.

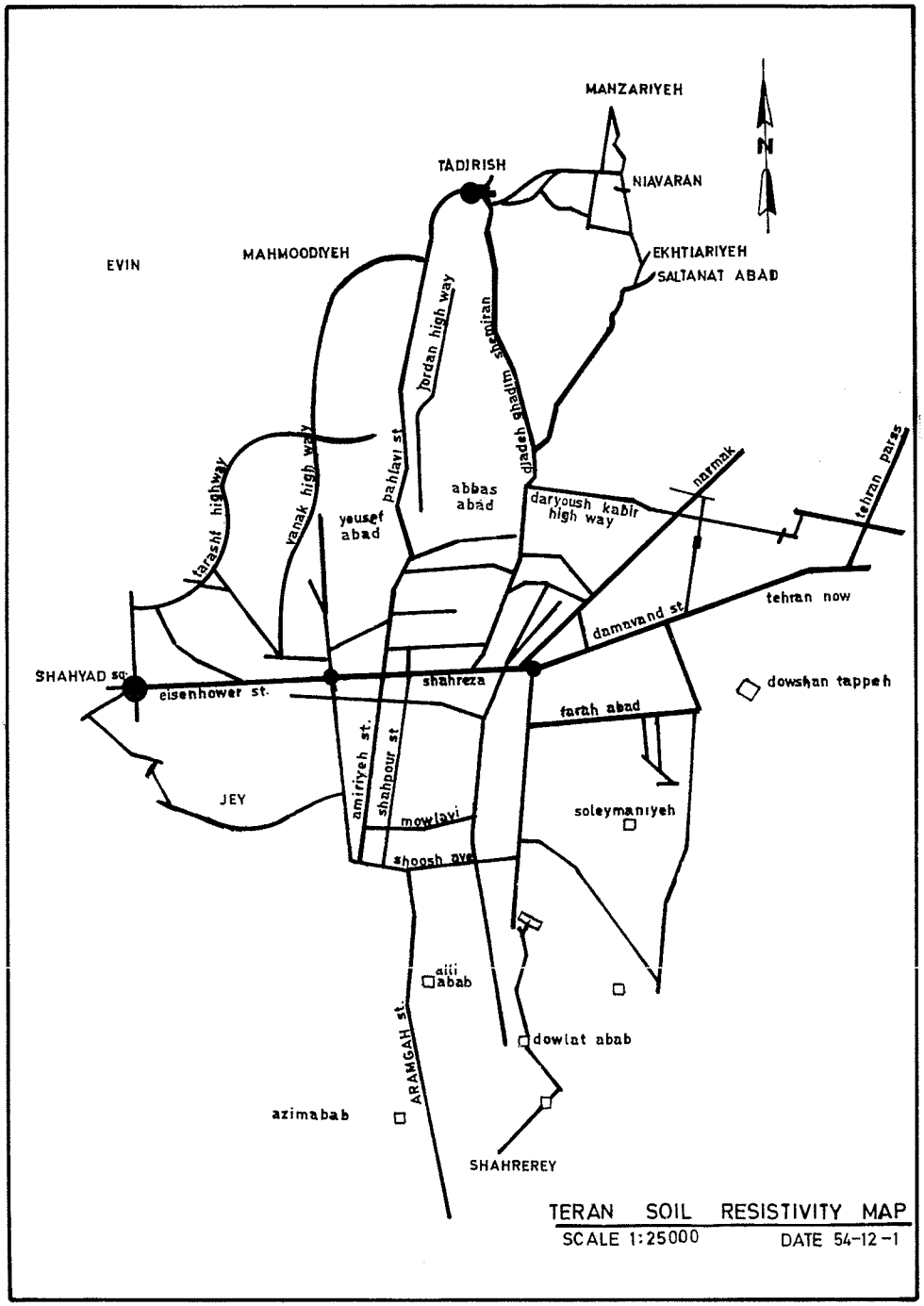
As most of the water pipes of Tehran Regional water company are buried at an average depth of 1.5 meter, the distance between electrodes were so chosen that the reading will give rather good picture of the soil at this depth around the pipe. Soil is also sampled and chemically analysed. According to tables the following can be studied:

1- The electrical resistivity of the soil at south of Tehran is about 1000 to 5000 ohm. cm. so can cause corrosion. So some kind of protection of pipes laid in these areas is necessary or pipe is selected with this point in mind.

2- The electrical resistivity of the soil at west part of Tehran is rather very low consequently utilization of steel pipes needs careful corrosion protection measures.

3- Generally the electrical resistivity of the soil at north part of Tehran is 3000-8000 ohm-cm. so utilization of steel pipes for water and gas needs certain consideration (5,12).

4- North west of Tehran has a soil with electrical resistivity of 10,000 ohm-cm. so corrosion is not considered real problem.



TERAN SOIL RESISTIVITY MAP

SCALE 1:25000 DATE 54-12-1

TABLE - I

RESULTS OF RESISTIVITY MEASUREMENT *

No.	Location of Measurement	Number of Measurement	Length of Measurement	Average of Measurement	Year of Measurement	Type of Pipe
1	Begining of Parkway toward Tadjrish	10	9	10278	1354	D.I.
2	Tadjrish Sq. toward Dr. Shariati Street	14	13	12643	1354	D.I. & C.I.
3	Argantin Sq. toward north	7	6	10348	1354	D.I.
4	End of Pasdaran toward South	6	5	11856	1354	D.I.
5	End of Amirabad toward South	2	2	26611	1354	D.I.
6	Begining of Shapoor toward North	7	6	6503	1354	C.I.
7	Shar-e-Ray Sq. toward north	7	7	3587	1354	D.I.
8	Shoush St. Close to old railway station	3	3	4462	1354	C.I.
9	Farah Abade Jaleh toward Coca Cola	6	5	6594	1354	D.I.
10	Azadi Sq. toward Karadje	14	13	18496	1354	Steel C.I. & D.I.
11	North of Tehran Pars toward south	3	3	8327	1354	D.I.
12	Begining of Narmak toward north	3	3	22613	1354	D.I.
13	Gorgan St.	3	2	25550	1354	D.I.
14	Seyed-e-Khandan toward Tehran Pars	6	6	20642	1354	D.I.

* Due to limited pages allocated for this article, the tables of measurements which are 13 pages is available with the author.

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TABLE - 2

CHEMICAL ANALYSIS OF SOIL

Date	Salts In Soil Extract P.P. m.	P.H.	E. C. m. r.	Chlo - ride %	Sulfide %	Moisture %	Location of Sampling
54/9/2	893.8	9.4	1420	0.41	0.08	13.018	Parkway Bld. Tavanir Junction
54/9/2	601.6	8.2	940	0.486	0.04	5.962	Parkway Bld. Close to Karadge Road.
54/9/2	467.2	9.8	730	0.237	0.04	8.518	Parkway Bld. Next to Niloofar
54/9/2	217.6	9	340	0.209	0.01	11.74	Parkway Bld. Next to main Buildings
54/9/4	832	7.8	1300	0.241	0.07	0.978	Amir Akram Cross Road
54/9/4	204.8	8.5	320	0.275	0.014	9.058	Dr. Mossaddegh Ave.
54/9/4	512	11.9	800	0.227	0.029	2.598	Mossaddegh St. Close to Vanak Square
54/9/4	115.2	8.2	180	0.192	0.007	8.812	Mossaddegh St. Close to Zoo
54/9/4	1088	7.8	1700	0.704	0.099	11.7	Mossaddegh St. Yousef-Abad Junction
54/9/9	249.5	8.5	390	0.108	0.02	8.6	Old Shemiran Road
54/9/9	921.6	8.2	1440	0.338	0.065	9.75	Kouroush-Kabir Takhte-Jamshid Junction
54/9/9	710.4	10.4	1110	0.094	0.04	6.87	Kouroush- Kabir Pole- Roome
54/9/9	192	8.3	300	0.129	0.01	10.242	Kouroush - Kabir Gholhak
54/9/9	838.4	9.4	1310	0.346	0.06	7.22	Kouroush - Kabir Seied-e- Khandan
54/9/9	1056	8.1	1650	0.412	0.08	9.166	Kouroush - Kabir Saltanat Abad Junction
54/9/11	268.8	7.9	420	0.28	0.014	8.272	Jordan
54/9/11	108.8	8.2	170	0.19	0.004	8.57	E. Boulvard Close to Pahlavi Hospital

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