

## SOME AFFECTS OF THE VIETNAMESE CLIMATE ON THE REINFORCING BAR'S CORROSION IN THE TRANSPORT CONSTRUCTIONS

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abstract: One of the main reason for the deterioration of reinforced concrete is corrosion. The reinforcement bar's corrosion causes cracking, loss of integrating of the concrete, decreasing the service capability of the structure. Therefore the assessment of the corrosion severity of the reinforcement is very important as necessary.

### 1. INTRODUCTION ON STEEL CORROSION

The corrosion of steel in concrete results from areas of steel becoming depassivated by chlorides and carbonation.

There are some criteria for the assessment of the corrosion severity in USA and UK based on the measurement of the voltage, resistance, chloride content in concrete. In each standard a threshold of the chloride level was set up. It shows that if the chloride content in concrete exceeds this threshold the reinforcement bar starts to be corroded. The chloride content in concrete, the threshold level of chloride content depends upon the kind of cement, the chloride content in the mixing water, sand, aggregate, cement and environment. The chloride penetration in the environment depends on temperature, humidity, chloride content in the atmosphere.

### 2. ABOUT VIETNAMESE CLIMATE

Table 1: Some characteristics of Vietnamese climate

Location	Average relative Humidity -(%)	Average air Temperature-(° C )	Smelted Chloride content-mg/m <sup>2</sup> -day
Halong- City	82	22.4	0.5-0.9
Haiphong- City	82.1	23.0	0.5-0.9
Hanoi- City	81.0	23.7	0.4-0.6
Vinh	84.5	23.8	0.6-1.0
Nhatrang	80.5	26.6	10-5.0
Ho chi Minh- City	88.6	27.0	0.8-1.1
Vung tau	80.5	26.9	5-15

It is shown that there are great differences of humidity in different areas. When the humidity is greater than 80% it will affect badly to the chloride content in cement. There is greatest settled chloride content in the coastal areas such as in Nhatrang, Vung tau. The chloride content depends on the distance from the sea . It decreases with the increasing distance from the sea coast. The chloride content falls rapidly in the north of Vietnam by the rate of 0.43 mg/ m<sup>2</sup>-day,km and by 0.04 mg/ m<sup>2</sup>-day-km in the South.

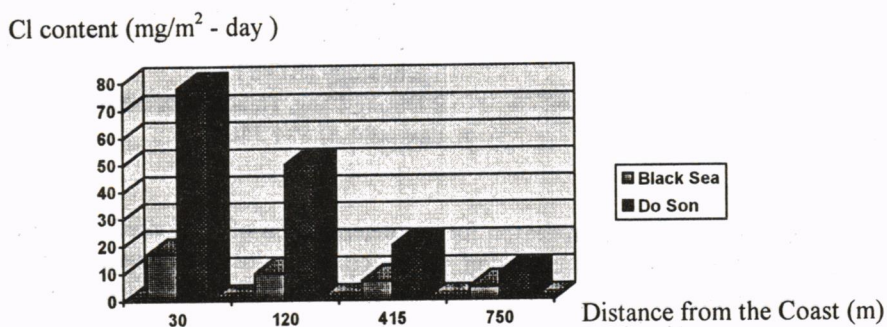


Figure 1: Change of the settled chloride content in Doson beach

### 3. OBSERVATION OF CORROSION ON CONSTRUCTIONS

It shows that there are many different conditions in the micro climate between the coastal area and the area far away from the sea greater than 500m.

Due to the geographical condition, many reinforced concrete transport constructions such as road railway network and sea port in Vietnam have been built along the coast with distance from the coast more than 500m, leading to the differences of chloride penetration rates. It is why the assessment of the durability of the constructions should be paid more attention.

Some different constructions located at the same area about 500m from the coast, built by the same concrete strength, design but different concrete covers have been investigated and resulted in following data:

Table 2: Reinforced bar conditions of some constructions covered by different concrete thickness

Construction	Year-built	Cement content in concrete kg/m <sup>3</sup>	Thickness of Concrete cover (mm)	Reinforced bar condition (observation)	Distance from the coast (m)
A	1977	297	15- 20	badly corroded	500
B	1977	290	15- 20	badly corroded	500
C	1957	338	30	not corroded	500
D	1960	338	30	not corroded	200
E	1978	362	8- 15	light corroded	near coast
F	1980	579	15- 20	not observed	near coast

**Table 3: The chloride content in some constructions protected by different concrete covers.**

Construction	Chloride content in concrete cover depth			
	10-20mm	30-40mm	40-50mm	60-70mm
A	1.1	0.68	0.57	0.4
C	1.4	0.55	0.38	0.34
E	5.3	3.5	1.7	1.2
F	3.54	2.4	1.95	1.4

The investigation the carbonation of the above constructions showed that the carbonation depth varies from 0-12mm so the influence of carbonation to capacity of destroying the passive layer is not remarkable.

#### 4. CONCLUSION

From the above results it is suggested that the threshold level of chloride content using for the assessment of corrosion for the constructions built in different distances from the coast needs to be reviewed, and the threshold level of 0.4% chloride fixed in some international standards using in Vietnam should be checked and reviewed. To get high durability of the constructions, the concrete cover must be at least 30mm.

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