

# Indication of Chloride Permeability in Pavement Cores at Various Ages

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## INTRODUCTION

Iowa has a number of pavements, 40 years and older, still in service without an overlay. Currently, there are over 700 2-lane miles greater than 40 years old.

Since air entrainment was not used until 1952, it was assumed that these old durable pavements must be impermeable to survive without air entrainment. Perhaps, the older slow setting Portland cements, with higher  $C_2S$ , produced concrete with a dense microstructure and thus, low permeability.



Figure 1. Eddyville Cemetery Rd 1909 (picture 2008)



Figure 2. Old US 20 Woodbury Co. 1921 (picture 2009)

Cores were obtained from a variety of pavements in Iowa ranging in age from the early 1900's to 2000's. The later concrete pavements utilized blended cements, both Type IP and Type IS, with Class C fly ash substitution.

## TEST RESULTS

Samples were obtained from the pavement cores and prepared for hardened air void analysis and rapid chloride permeability testing.

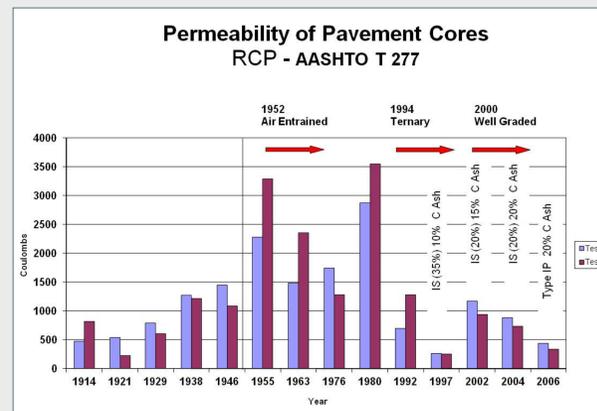


Figure 3. RCP Test Results of Pavement Cores

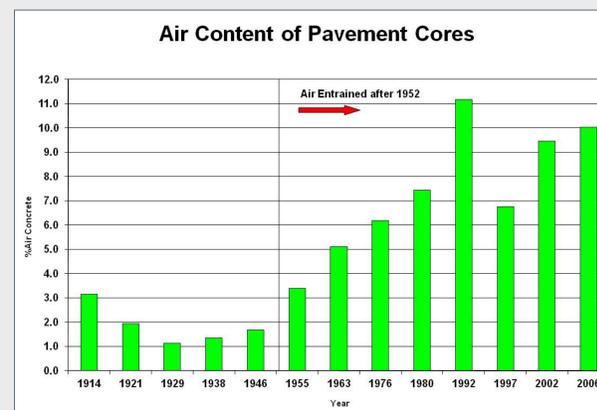


Figure 4. Hardened Air Content of Pavement Cores

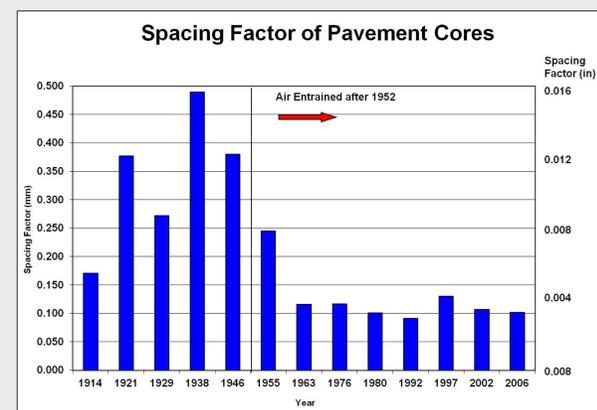


Figure 5. Spacing Factor of Pavement Cores

## DISCUSSION

Many changes have occurred over the past century. Cement chemistry and curing may be two of the biggest changes.

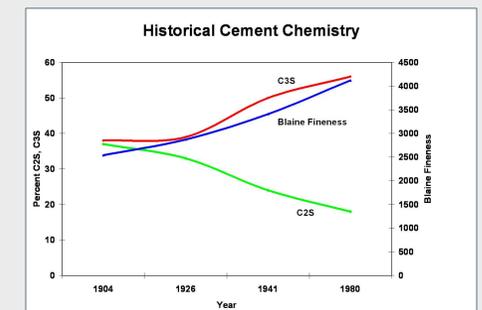


Figure 6. Changes in Cement Chemistry



Figure 7. Earth curing (7 days)

The RCP testing indicated greater resistance to chloride permeability in the older pavements. Ternary mix designs also indicate a greater resistance to chloride permeability.

It was interesting to note the excellent performance of the older pavements without air entrainment, while some pavements placed in the 1980's exhibited deterioration problems due to low air content. It was speculated that if the permeability is low enough, air may not be needed. Subsequent research at Iowa State University (ISU) indicated that it is extremely difficult to produce F/T durable concrete without air entrainment. Only one mix design using blended cement, a w/c less than 0.25, and compressive strength greater than 12,000 psi passed F/T testing without air entrainment.