

MIP of Cementitious Pastes

Jiake Zhang
Ph.D. Candidate
Iowa State University

Dr. Peter Taylor PE (IL)
Associate Director
CP Tech Center

National Concrete Pavement
Technology Center



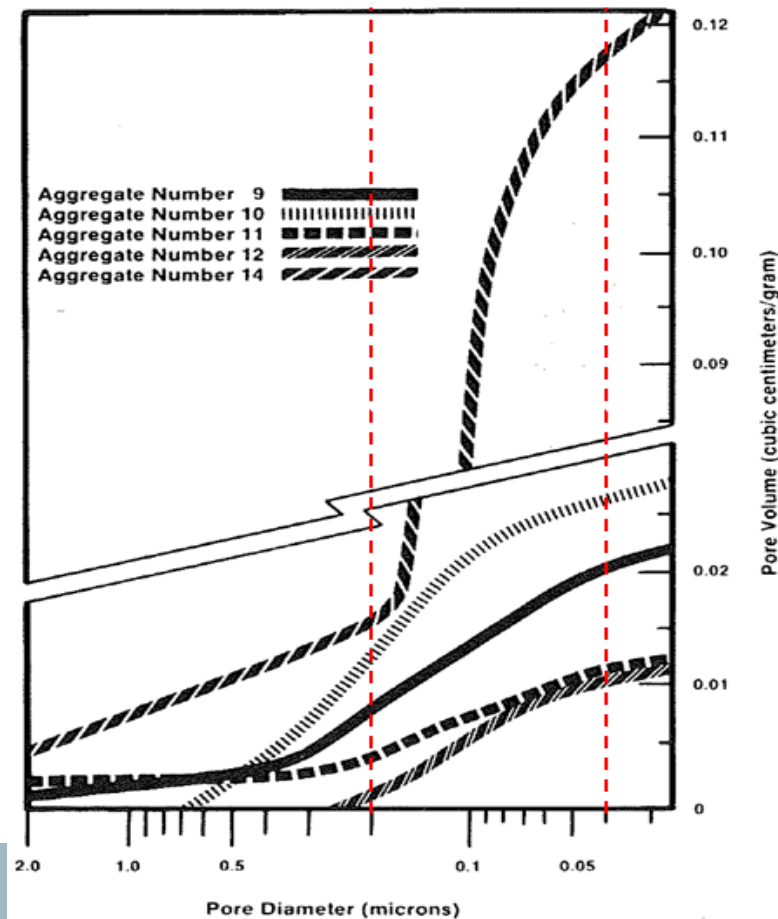
Field observation

- Good sidewalk but distressed parking lot
- Could there be a parallel with D-cracking aggregates?



The Aim

- Aggregates prone to D-cracking reportedly show a unique signal when tested in MIP
- What about paste?

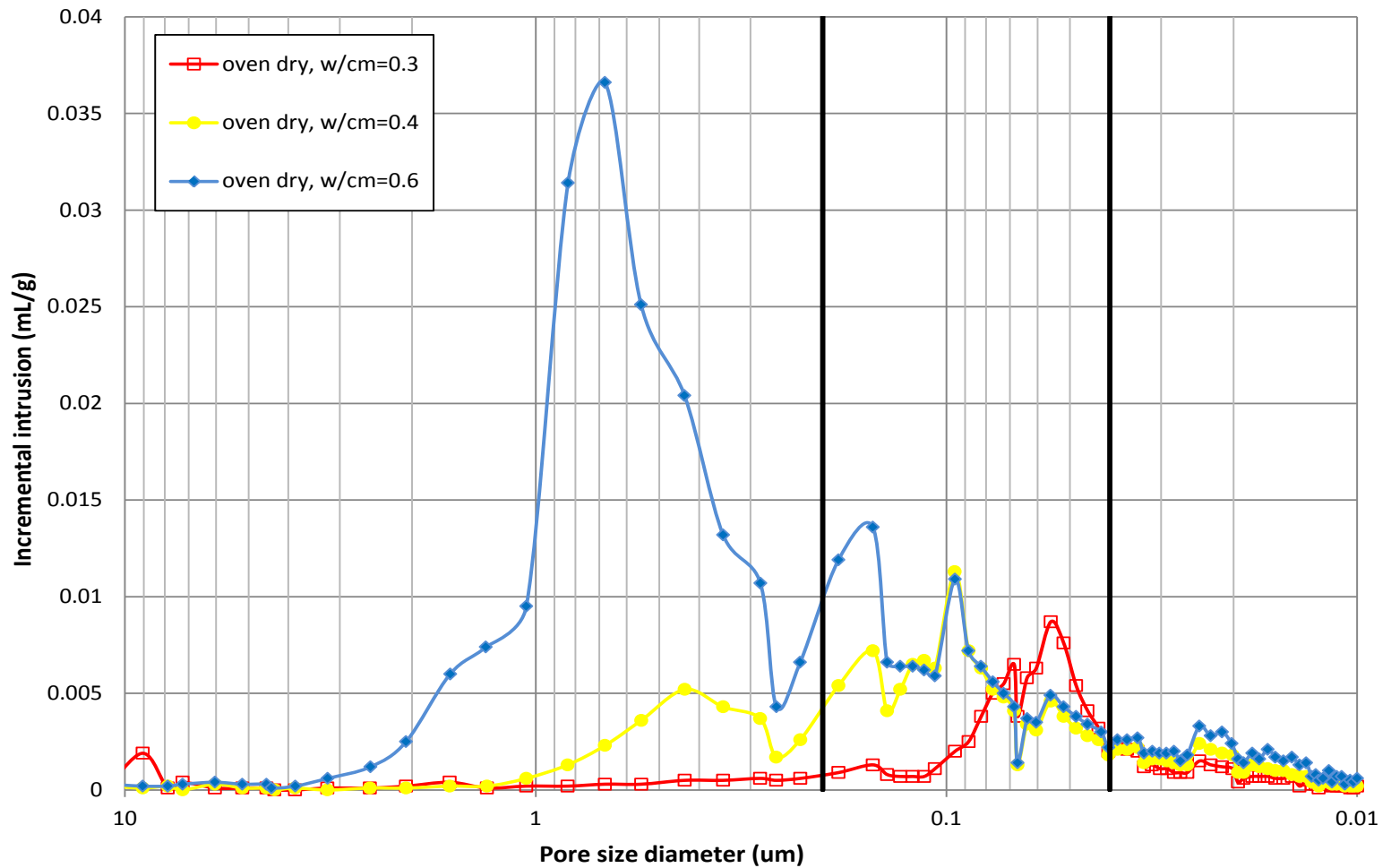


Phase I: Oven dried samples

- $w/cm = 0.3, 0.4, 0.6$
- Binder – Plain
- Placed in plastic containers and rotated for 24 hours at the speed of 8 second per cycle
- Samples were sealed in bottles for 7 days, then oven dried ($T=50^{\circ}C$) till constant mass reached prior sending to commercial lab

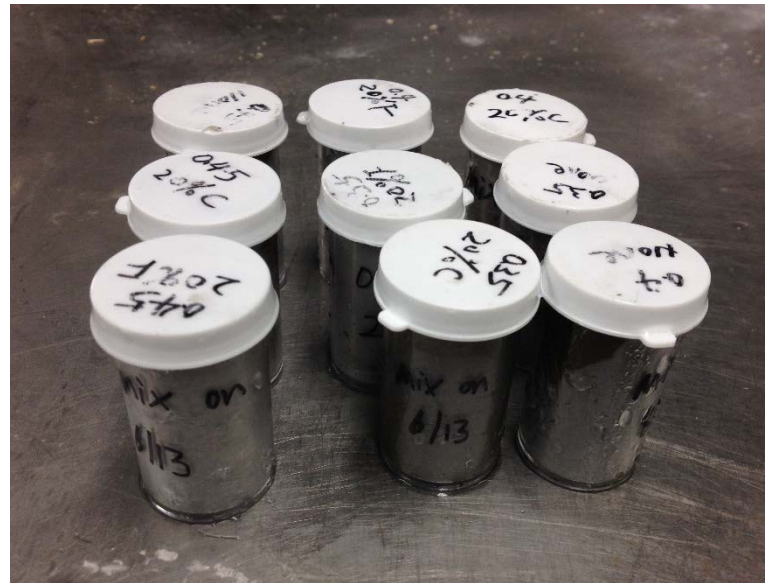


Plain cement paste

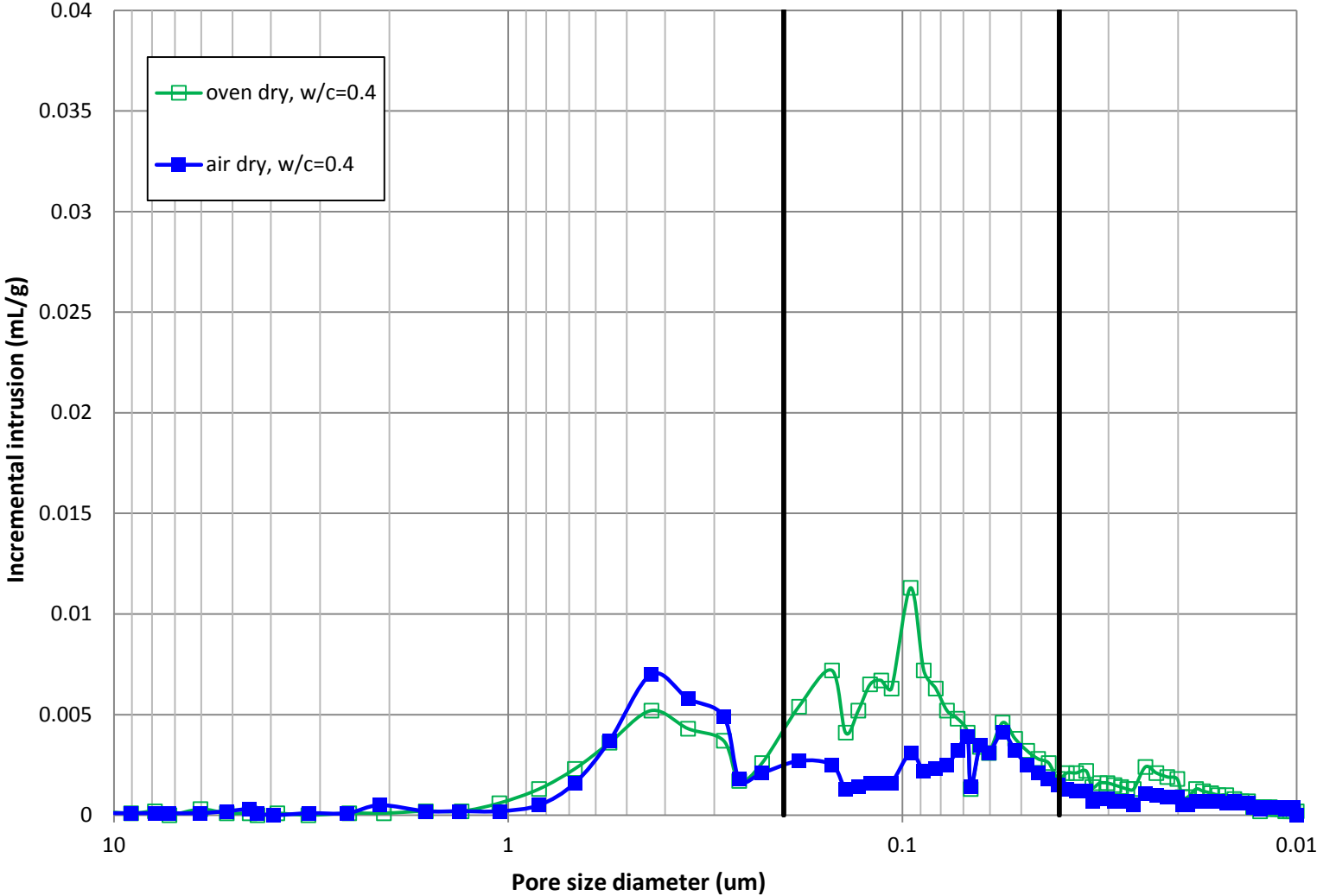


Phase II: Air dried samples

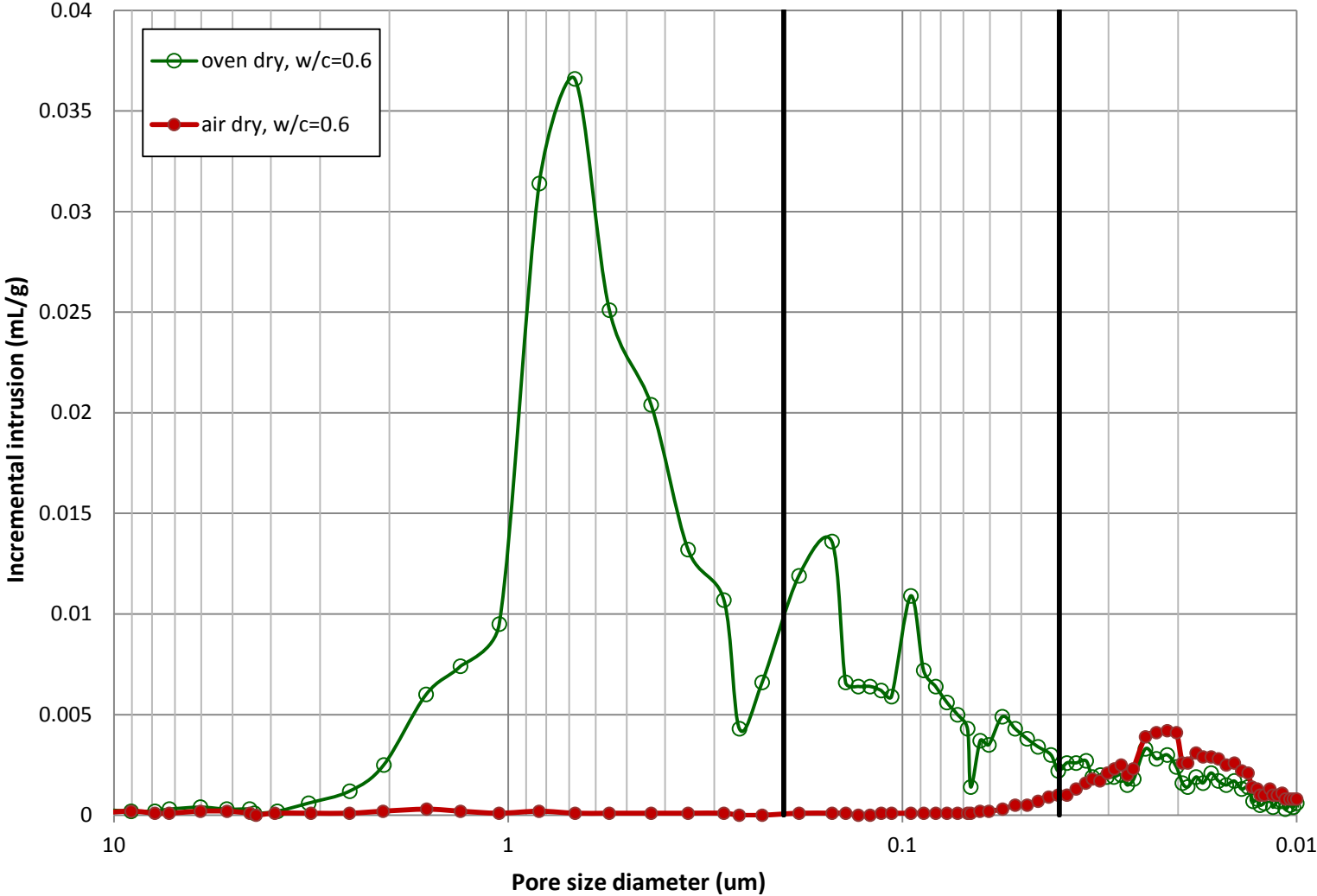
- Variables:
 - w/cm: 0.35, 0.40, 0.45, and 0.60
 - Binder: plain, 20% C fly ash
- Placed in plastic containers and rotated for 24 hours
- Then placed in wet room for 28 days. Air dried for 7 days before sending to commercial lab



Air dry vs. Oven dry: $w/cm=0.4$

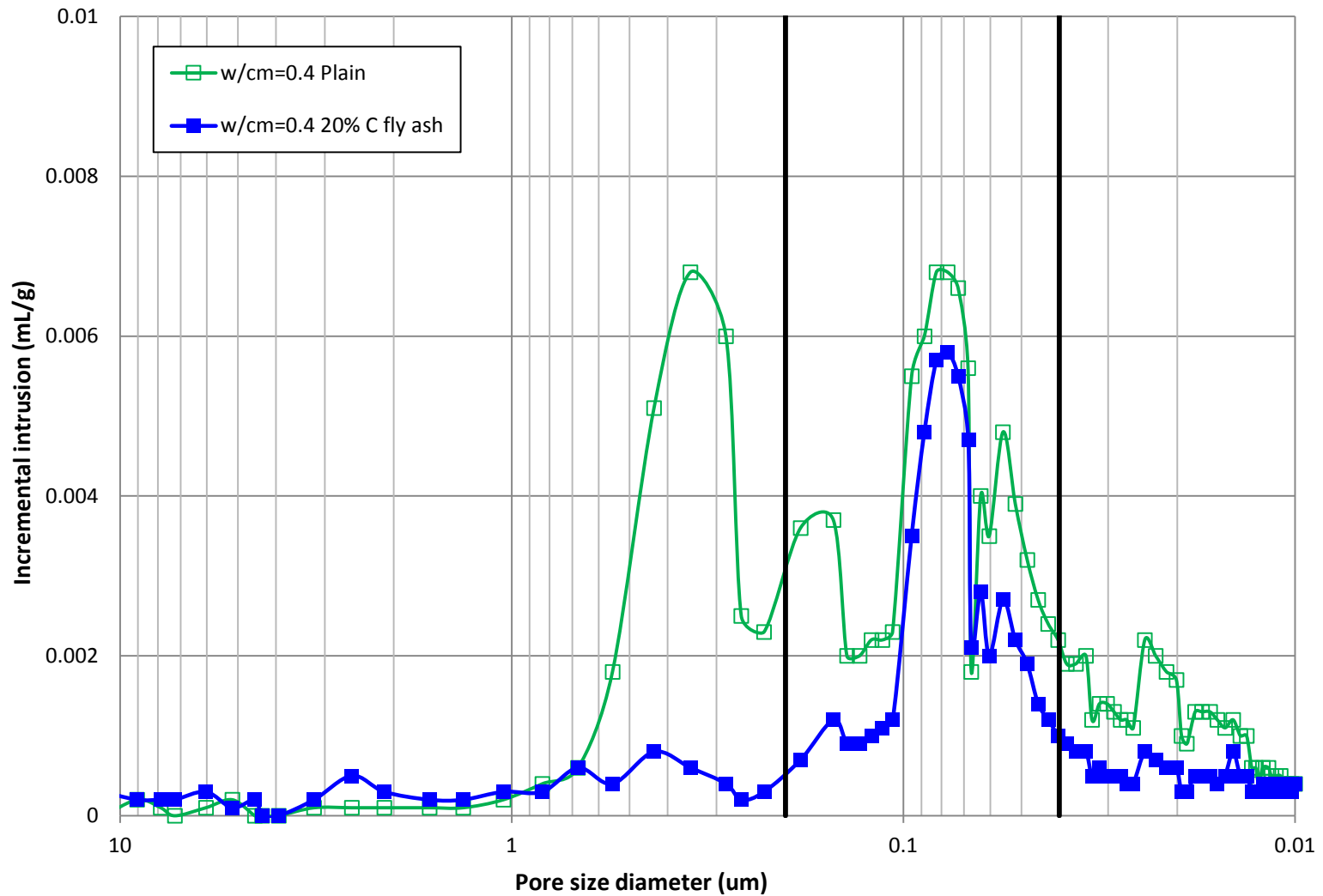


Air dry vs. Oven dry: $w/cm=0.6$

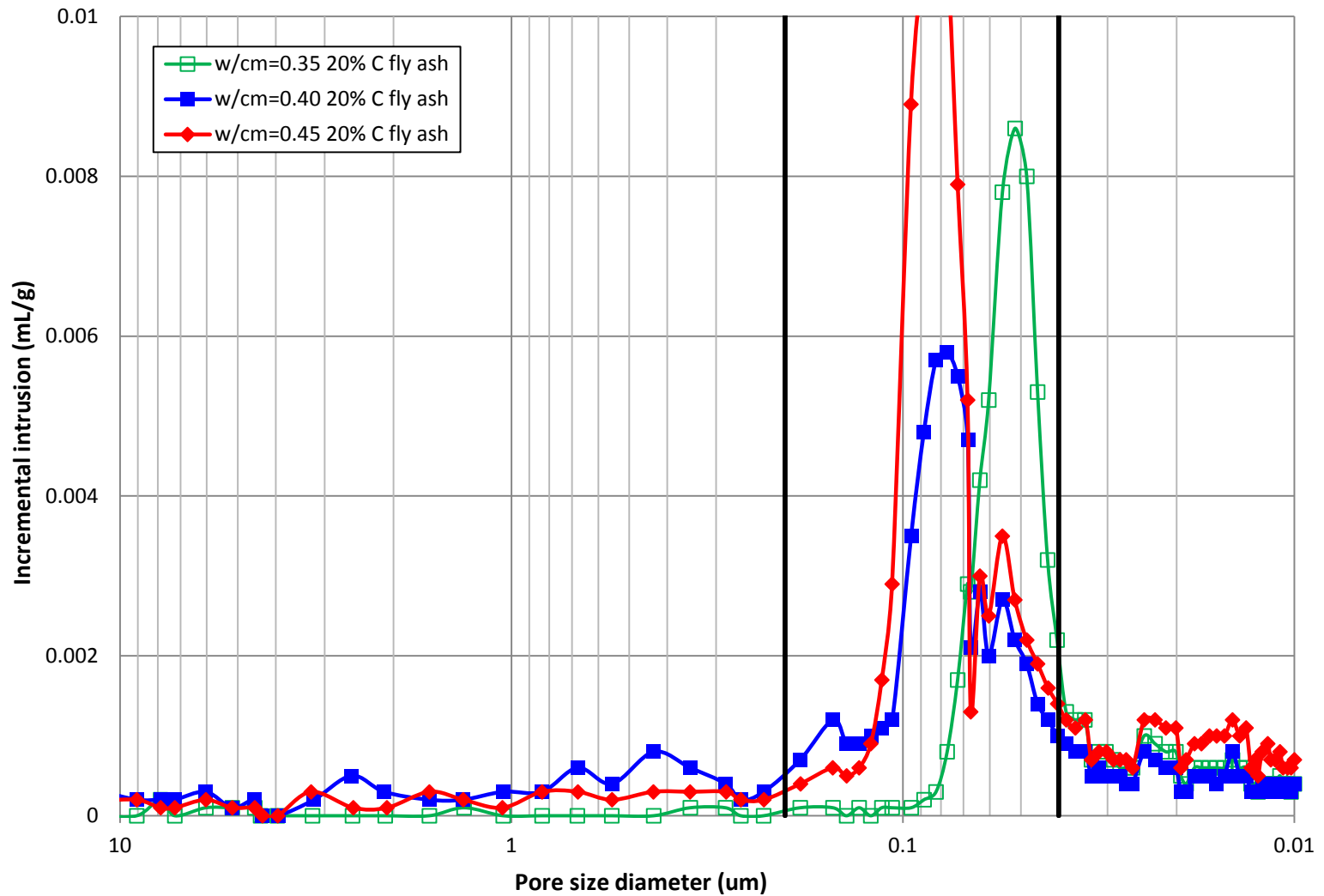


Effect of adding fly ash

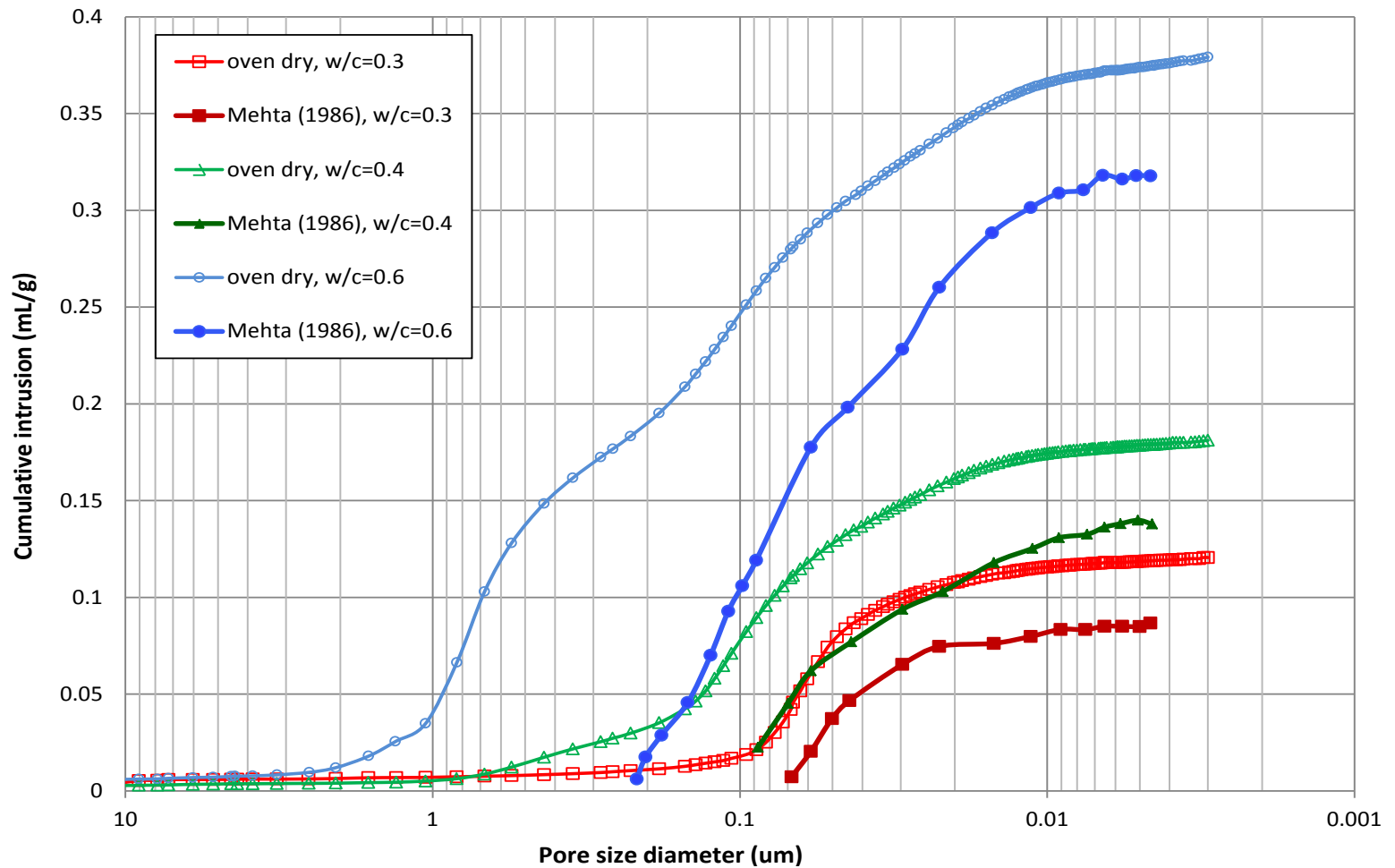
Air dry, $w/cm=0.4$



20% C fly ash, air dried



Compare with data from Mehta (1986)



Discussion

- Porous medium with intermediate sized pores are reportedly less durable in freezing and thawing
 - Can easily reach to high degree of saturation
 - Freezing of the absorbed water causes expansion
- Fine pores are durable because
 - Limited water access
 - Freezing point depression
- Coarse pores also durable because water can easily drain

Conclusions

- Increase w/cm ratio increases the total porosity, and increases the pore size
- Water in air dry sample prevents mercury from getting in, which results in smaller pores and lower porosity
- Longer curing time results in lower porosity
- C fly ash reduces the pore size of cement paste
- Seems that pores in typical pavement mixtures are in the “trouble zone”

- More work needed