

To : Mr. S. K. Oh / Dept. of Architectural Design of Seoul National Polytechnical University
Ph.D. and P.E. in Material Section of Architectural Engineering
CC to : ACT, USA of PROTECRETE-CDS through ACT, Asia.
Submitted by : ProCon Corp., Seoul, Korea on Oct. 21, 1996
Analysed by : Ph.D. Mr. J. H. Kim of Hanil Cement Manufacturing Co., Ltd. in Korea

<< 지하철 콘크리트 기반 코아에 대한 분석 결과 >>

Preliminary Analyses Report on Core of Concrete Foundation under the Subway Rail

1. 도포장소 : 지하철 1호선 '종로 5가역 (홈 오른쪽 끝부분)
Site Sprayed on Concrete Foundation under the Subway Line # 1 Rail
2. 도포일 : 1996. 9. 19.
3. 도포방법 : 고압분사기로 분사함. *Sprayed by Airless Pump*
4. 코아채취 : 1996. 9. 20. *Date of Sampling(Core)*
5. 채취부분 : 1주일 전 신규 타설한 곳과 18년전 타설된 곳.(100Dia. x 220mmL)
Each Cores are cut-off on 1 week & 18 years old concretes.
6. 분석일 : 1996. 10. 18. *Date of Analyses*
7. 분석의뢰처: 한일시멘트 대전연구소 시멘트 연구실
Laboratory : Hanil Cement Manufacturing Co., Ltd.(Taejon city)
8. 분석자 : 김정환 박사 외 다수 *Analysers : Ph.D.. Mr. J. H. Kim & others*
9. 시험방법 : *Analyses Method*
 - ① CDS용제의 분석 (*Analysis of CDS liquid*)
 - ② 코아의 X선 회절분석 (*XRD; X-Ray Diffrometer*)
 - ③ 조직의 현미경 관찰 (*SEM*)
10. 결과 : 상세 사항은 불임 참조. (*Please refer to the sheets of Analyses Result*)

- ① CDS는 비정질의 실리카로써 콘크리트 조직내의 고침투가 가능하며,
(재령기간 1주일 짜리 시편은 200mm까지 완전히 침투하였으며, 18년 짜리는
30~50mm까지 침투가 확인됨. 재령기간이 짧을 수록 침투가 빠름.)
*It is confirmed that CDS is typical Colloidal Silica and can absorbing into the
concrete very deeply. (1 week old Core was absorbed into 200mm and
30~50mm in case of 18 years old. They say that the shorter is the period of
concrete care , the faster is the penetration into concrete.)*
- ② CDS용제내 Polymer성분이 포함되어 있는 것으로 판단되고, 고침투에 의해
조직내의 잔존 수산화물인 Ca(OH)₂가 완전히 C-S-H화함으로써 방수효과와 강도
및 내구성, 연신성 등의 증가효과가 있는 것으로 판단됨.

특히, 1주일 짜리 시편의 경우, 조직내의 Fly-ash가 통상 28일이 지나면서
변화(C-S-H)하는 데 비해 CDS도포의 경우 빠른 변화를 보여 주고 있음.
*They are sure that some contents of Polymer is included in CDS liquid. Unused
Calcium Hydroxides such as Ca(OH)₂ seems to be C-S-H by reaction with CDS,
which makes sure of Waterproofing, Durability & Elongation etc.*

*Especially, Fly-ash in 1 week old Core shows to be acting into C-S-H by CDS
even if the period of concrete care is very short.*

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<< 지하철 콘크리트 기반 시편에 대한 분석 결과(상세) >> 2/2

Preliminary Analyses Report on Core of Concrete Foundation under the Subway Line # 1 Rail (Chongno 5-Ga Station) In Seoul.

2) 콘크리트 시편에 대한 분석결과 Analysis on Concrete Core

분석방법 Method	φ 100 x 200mmL의 시편을 10mm씩 절편하여 차례로 조직내 잔존수화물 Ca(OH) ₂ 의 표출확인. Reaction against Ca(OH) ₂ for 20 specimen sliced in 10mm by turns.	
절편의 깊이 Depth of sliced Core	Ca(OH) ₂ 표출여부 Where is Ca(OH) ₂ ?	
	재령18년 짜리 18 years old Core	재령1주일 짜리 1 week old Core
맨 윗부분 Top	안나타남.(×) Not shown	안나타남.(×) Not shown
위에서 30 ~ 50mm below top	안나타남.(×) Not shown	안나타남.(×) Not shown
위에서 100mm below top	나타남.(○) Shown	안나타남.(×) Not shown
맨 아래 200mm below top	나타남.(○) Shown	안나타남.(×) Not shown

결과에 대한 의견
Opinion on Result

① 재령 18년 짜리의 경우 30mm~50mm부분까지 침투한 것을 확인하였으며, 1주일 짜리에는 전혀 Ca(OH)₂ 나타나지 않음.
 In case of 18 years old Core, it was shown at the depth of 30-50mm below top but NO shown in case of 1 week old Core upto 200mm below top.

② 이것은 본 CDS의 Colloidal Silica가 침투→Pozzolan반응→전량 C-S-H로 바뀐것으로 판단됨.
 They think that CDS was penetrated to result into "CDS-Colloidal Silica→Pozzolan Reaction→All C-S-H."

③ Fly-Ash가 Pozzolan반응하여 일부 C-S-H가 되기에는 재령기간이 너무 짧기 때문에 Fly-Ash의 영향은 아닌 것으로 판단됨.
 They are sure that All C-S-H is not resulted by Fly-Ash because the period of concrete cure is too short(1 week).

④ 육안 침투 시험결과 상당히 양호한 침투를 보였음.
 They saw with the naked eyes that the penetration was very good.

⑤ 방수외에도 강도 증가, 내구성 향상 등의 효과가 있는 것으로 판단됨.
 They are sure that CDS can effect on high Waterproofing, Strengthening & Durability etc.

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<< 지하철 콘크리트 기반 시판에 대한 분석 결과(상세) >> 1/2

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1) CDS용제에 대한 분석결과 Analysis on CDS Liquid

분석방법 Method	결과 Result	결과에 대한 의견 Opinion on Results	질문사항 Question from Operators
그라프 분석 Graph	전형적인 비정질 실리카임을 확인함. CDS is typical Colloidal Silica.	고침투가능(CDS의 경우 150 - 200mm침투가능) Confirmation on penetration upto 150 200mm.	① 실리카 함유 함량 11% ? How much % Silica is included in CDS ? 11% ? ② CDS용제내 분산제의 종류 ? What kind of "Dispersion Solution" is included in CDS ? They think that SiO ₂ is dispersed into Si, H ₂ O etc , which is different with other SiO ₂ -Series waterproofing material.
고온가열 Heating	380℃에서 발열을 확인함. Burned at 380℃	방수 및 내구성증가(탁월한 방수 효과, 강도 및 내구성 등이 증가) High Waterproofing, Durability & Elongation etc.	③ Polymer성분이 함유되었는 가 ? Is Polymer contents included in CDS ? ④ Polymer성분 : SBR, Stearin산 ? What kind of Polymer, if included ? SBR or Stearin acid ?
			⑤ 방수의 Mechanism ? C-S-H조직치밀화(Pozzolan) 혹은 Hydro-Phobic Mechanism ? How is mechanism for Waterproofing ? ⑥ 미국내 방수제의 동향 ? How is the trend of Waterproofing Material in U.S.A. ? ⑦ 본 CDS는 방수목적외에 강도증기 등의 다른 목적에 따라 개발된 것인가 ? They want to know whether or not this CDS is aimed for Waterproofing ability at the initial stage or other effects such as Durability etc.

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<< 지하철 콘크리트 기반에서 채취한 코어 사진 >>

Pictures for Sampling(Core) on Concrete Foundation under the Subway Rail in Seoul

