ПЕНЕТРОН ИСПЫТАНИЯ

ОПРЕДЕЛЕНИЕ ВОДОНЕПРОНИЦАЕМОСТИ

15/09/2001		
	Испытательный центр НИЦстром при ВНИИжелезобетоне, г.Москва	
	Проведение сравнительной оценки водонепроницаемости бетонов марки 400 контрольного «К» и обработанного материалом Пенетрон «Р»	
	Испытания проводились по ГОСТ 12730.5-84 Бетоны. Методы определения водонепроницаемости	
Результаты испытаний		
Индекс партии	Сопротивление бетона проникновению воздуха, сек/см^3	Марка бетона по водонепроницаемости, W
«К»	28,6	12
«Р»	62,6	18

03/12/2001		
	Научно-исследовательский, проектно-конструкторский и технологический институт бетона и железобетона ГУП«НИИЖБ», г.Москва	
	Определение водонепроницаемости бетона обработанного материалом Пенетрон	
	Испытания проводились по ГОСТ 12730.5-84 «Бетоны. Методы определения водонепроницаемости (по мокрому пятну) на образцах-цилиндрах 15х5см. Водонепроницаемость бетона оценивалась после удаления нанесенного слоя гидроизоляционного материала, максимальным давлением воды, при котором на 4-х из 6-ти образцов не наблюдалось признаков фильтрации воды.	
Результаты испытаний		
	Бетон без защиты (контрольные образцы)	Бетон, обработанный материалом Пенетрон
Марка бетона	300	300
Возраст бетона, дн.	28	28
Марка по водонепроницаемости	W-2	W-8

30/08/2005		
	Научно-исследовательский, проектно-конструкторский и технологический институт бетона и железобетона ГУП«НИИЖБ», г.Москва	
	Определение водонепроницаемости бетона обработанного материалом Пенетрон	
	Испытания проводились по ГОСТ 12730.5-84 «Бетоны. Методы определения водонепроницаемости (по мокрому пятну) на образцах-цилиндрах 15х5см. Водонепроницаемость бетона оценивалась после удаления нанесенного слоя гидроизоляционного материала, максимальным давлением воды, при котором на 4-х из 6-ти образцов не наблюдалось признаков фильтрации воды.	
Результаты испытаний		
	Контрольные образцы	Бетон, обработанный материалом Пенетрон
Возраст бетона, дн.	75	75
Марка по водонепроницаемости - прямое давление - обратное давление	 W-2 W-2	 W-10 W-8

12/11/2007 **ОТЧЕТ 9747**		
	Белорусский Национальный Технический Университет (БНТУ), г.Минск	
	Определение водонепроницаемости бетона обработанного материалом Пенетрон	
	Испытания проводились по ГОСТ 12730.5-84 «Бетоны. Методы определения водонепроницаемости (по мокрому пятну) на образцах-цилиндрах 15х5см. Водонепроницаемость бетона оценивалась максимальным давлением воды, при котором на 4-х из 6-ти образцов не наблюдалось признаков фильтрации воды.	
Результаты испытаний		
	Контрольные образцы	Бетон, обработанный материалом Пенетрон
Марка по водонепроницаемости	W-2	W-12

ОПРЕДЕЛЕНИЕ ВОДОНЕПРОНИЦАЕМОСТИ РАДИАЦИОННО НАГРУЖЕННОГО БЕТОНА

17/04/2003	**ОТЧЕТ №22/19**	
	Лаборатория ОАО ПТО «ПРОГРЕСС», г.Екатеринбург	
	Определение влияния гидроизоляционного состава Пенетрон на водонепроницаемость радиационно нагруженного бетона	
	После гамма-облучения в Федеральном Ядерном Центре (РФЯЦ-ВНИИТФ)образцы прошли испытания на определение водонепроницаемости в соответствии с ГОСТ 12730.5-84.	
Результаты испытаний		
	Группа А (контрольная)	Группа Б (с «Пенетроном»)
Марка бетона	300	300
Возраст бетона, дн.	28	28
Гамма-облучение, Мрад	500	500
Марка по водонепроницаемости	W-0 (бетон с повышенной фильтрацией)	W-2

06/05/2003	**ОТЧЕТ №22/25**	
	Лаборатория ОАО ПТО «ПРОГРЕСС», г.Екатеринбург	
	Определение влияния гидроизоляционного состава Пенетрон на водонепроницаемость радиационно нагруженного бетона	
	После гамма-облучения в Федеральном Ядерном Центре (РФЯЦ-ВНИИТФ) образцы прошли испытания на определение водонепроницаемости в соответствии с ГОСТ 12730.5-84.	
Результаты испытаний		
	Группа А (контрольная)	Группа Б (с «Пенетроном»)
Марка бетона	300	300
Возраст бетона, дн.	28	28
Гамма-облучение, Мрад	1000	1000
Марка по водонепроницаемости	W-0 (бетон с повышенной фильтрацией)	W-2

ОПРЕДЕЛЕНИЕ МОРОЗОСТОЙКОСТИ

15/09/2001	
	Испытательный центр НИЦстром при ВНИИжелезобетоне, г.Москва
	Проведение сравнительной оценки морозостойкости бетонов марки 400 контрольного «К» и обработанного материалом Пенетрон «Р»
	Испытания проводились по ГОСТ 10060.0-95 Бетоны. Ускоренные методы определения морозостойкости при многократном замораживании и оттаивании

Результаты испытаний

Индекс бетона	Контрольные образцы		Основные образцы			Оценка $M_{рз}$ по Δ R,%
	Масса, кг	Прочность, R, Мпа	Число циклов	Масса, кг	Прочность, R, Мпа	
«К»	2,50	45,2	200	2,54	47,5	+5,1
			300	2,48	46,3	+2,9
«Р»	2,49	46,1	200	2,55	48,3	+5,7
			300	2,49	47,4	+3,0

08/10/2007		
	МУП «Казметрострой», Центральная производственно-строительная испытательная лаборатория, г.Казань	
	Определение марки по морозостойкости бетона с материалом Пенетрон	
	Испытания проводились по ГОСТ 10060.2	
Результаты испытаний		
	Контрольные образцы	Образцы бетона с добавкой Пенетрон Адмикс
Класс бетона по прочности	B15	B15
Возраст бетона, дн.	28	28
Марка по морозостойкости	F 100	F 300

30/08/2005		
	Научно-исследовательский, проектно-конструкторский и технологический институт бетона и железобетона ГУП«НИИЖБ», г.Москва	
	Определение водонепроницаемости бетона обработанного материалом Пенетрон	
	Испытания проводили в соответствии с требованиями ГОСТ 10060.2-95 «Бетоны. Методы определения морозостойкости». Морозостойкость определяли по ускоренному методу (третий метод) при многократном переменном замораживании-оттаивании на образцах кубах 7х7х7 см.	
Результаты испытаний		
	Контрольные образцы	Бетон, обработанный материалом Пенетрон
Марка по морозостойкости	F 100	F 200

ОПРЕДЕЛЕНИЕ ПРОЧНОСТИ НА СЖАТИЕ

15/09/2001							
	Испытательный центр НИЦстром при ВНИИжелезобетоне, г.Москва						
	Проведение сравнительной оценки прочности на сжатие бетонов марки 400 контрольного «К» и обработанного материалом Пенетрон «Р»						
	Испытания проводились по ГОСТ 10180-90 Бетоны. Методы определения прочности по контрольным образцам						
Результаты испытаний							
Индекс партии	Прочность бетона в возрасте:						
	28 дней R, МПа	45 дней		90 дней		120 дней	
		R, МПа	ΔR, %	R, МПа	ΔR, %	R, МПа	ΔR, %
«К»	43,9	46,7	6,4	48,6	10,7	56,6	28,9
«Р»		46,7	6,4	50,8	15,7	57,1	30,1

ОПРЕДЕЛЕНИЕ ПРОЧНОСТИ НА СЖАТИЕ РАДИАЦИОННО НАГРУЖЕННОГО БЕТОНА

06/05/2003	**ОТЧЕТ №22/26**	
	Лаборатория ОАО ПТО «ПРОГРЕСС», г.Екатеринбург	
	Определение влияния гидроизоляционного состава Пенетрон на прочность на сжатие радиационно нагруженного бетона	
	После гамма-облучения в Федеральном Ядерном Центре (РФЯЦ-ВНИИТФ) образцы прошли испытания на определение прочности на сжатие в соответствии с ГОСТ 10180.	
Результаты испытаний		
	Группа А (контрольная)	Группа Б (с «Пенетроном»)
Марка бетона	300	300
Возраст бетона, дн.	28	28
Гамма-облучение, Мрад	1000	1000
Прочность на сжатие, Мпа	37,8	46,3

PENETRON TEST REPORTS

CHEMICAL RESISTANCE TESTING

10/19/1993	REPORT NO. 93-3981
	Shimel and Sor Testing Laboratories, Inc., Cedar Grove, NJ.
	Laboratory Testing of Penetron Waterproofing Materials for Chemical Resistance
	Result: The Penetron treated concrete was found to be resistant to acidic and alkaline conditions ranging between pH values of 3 to 11. The untreated concrete (control) had surface weathering when exposed to pH of 3, rain water chlorides and sulfate solutions.

CHLORIDE RESISTANCE TESTING

6/10/1983	ISLAND TESTING EGP. ASSOCIATION INC.
	Durability of Concrete and Penetration of de-icing chemicals into concrete were evaluated by freeze-thaw testing of treated and untreated concrete panels
	Result: For the conditions of this test, the surface treatment reduced the chloride concentration at the 1” depth by 50% at the 3” depth by 67% and at the 5” depth by 75% of that in the untreated panels.

COMPRESSIVE STRENGTH TESTING

3/4/1985	ALL ISLAND TESTING ASSOCIATION INC.
	To Determine if the Compressive of Concrete is Affected by Treatment with Penetron
	Result: The use of Penetron resulted in a strength gain of approximately 5.52% over the untreated concrete.

11/22/1993	REPORT NO. 93-4559
	Shimel and Sor Testing Laboratories, Inc., Cedar Grove, NJ.
	Laboratory Testing of the effects of Penetron Treatment on the Compressive Strength of Concrete
	Result: The treating concrete surface with Penetron resulted in a slight increase in the compressive strength of the concrete.

12/21/1994	**REPORT NO. 94-6175**
	Shimel and Sor Testing Laboratories, Inc., Cedar Grove, NJ.
	Laboratory Testing of Penetron Waterproofing Materials
	Result: As per ASTM C93, the Penetron treated and the untreated (control) cylinders were slightly higher than the untreated cylinders. This increase corresponds to approximately 6% gain over the untreated concrete. Primary benefit of Penetron is waterproofing concrete surface rather than increasing the compressive strength.

7/15/1997	**REPORT NO.: B 20297/BSB/1**
	Setsco Services PTE LTD
	Determination of Compressive Strength of Concrete Applied with Penetron Cementitious Capillary Waterproofing System

Table 1: Compressive Strength							
Sample Reference	Control			Treated with Penetron			
Cube Reference	1	2	3	1	2	3	
Date of Cast	11/4/1997						
Date of Test	18/04/97						
Age of Test	7						
Compressive Strength (N/mm^2)	24.0	24.0	24.0	24.5	24.0	24.5	
Average Compressive Strength (N/mm^2)	24.0			24.5			

Table 2: Compressive Strength Test									
Sample Reference	Control			Treated with Penetron			Treated with Penetron Slurry after 28 days of curing		
Cube Reference	1	2	3	1	2	3	1	2	3
Date of Cast	11/4/1997								
Date of Test	9/5/1997			10/5/1997					
Age of Test	28			29					
Compressive	30.5	30.5	31.0	36.5	35.5	35.0	35.5	36.0	36.0

Strength (N/mm^2)									
Average Compressive Strength (N/mm^2)	30.5			35.5			36		

FREEZE-THAW RESISTANCE TESTING

6/10/1983	**ISLAND TESTING EGP. ASSOCIATION INC.**
	Durability of concrete and Penetration of de-icing into concrete were evaluated by freeze-thaw testing of treated and untreated concrete panels.
	Result: For the conditions of this test, the surface treatment reduced the chloride concentration at the 1" depth by 50% at the 3" depth by 67% and at the 5" depth by 75% of that in the untreated panels. Visual examination of the panels after completion of the cycles showed a markedly increase in surface erosion of the untreated panels over the treated panels.

GAMMA RADIATION

6/19/1993	**CERTIFICATE NO. 9305-4136**
	Shimel and Sor Testing Laboratories, Inc., Cedar Grove, NJ.
	Exposure of Penetron Treated Concrete to Gamma Radiation
	Result: visual comparison, photographs and the adhesion test performed on the Penetron coating both before and after exposure to 5.76×10^4 of gamma radiation do not reveal any perceptible ill effects or damages. The defects as listed under USA Standard No. Rads N6.9-1967 "Protective Coatings (Paints) for the Nuclear Industry" were evaluated. No fine line cracking (ASTM D661-44), checking (ASTM D660-44), alligatoring, mud cracking (ASTM D661-44), blistering (ASTM D714-56), flaking (ASTM D772-47), discoloration, delamination and chalking (ASTM D659-44) were observed. The categories embrittlement, bubbling, blistering (ASTM D714-56), orange peeling, catalyst migration are not applicable because the Penetron material, according to the technical literature does not act strictly as a surface covering, but rather a treatment which is absorbed into the voids and capillaries of the concrete, later filling these areas with crystalline structures.

7/15/1997 REPORT NO.: B 20297/BSB/2A

Setsco Services PTE LTD

Comparative Test for Water Permeability on Plain Grade 30 Concrete Applied with Penetron Cementitious Capillary Waterproofing Systems (powder)

Permeability Test at 3.0 kgf/cm^2

Sample Reference	Control			Treated with Penetron Cementitious Capillary Waterproofing System Powder		
	C1	C2	C3	T1	T2	T3
Dimensional Measurement Avg. Diam. (mm)	101.1	100.0	100.0	99.9	100.3	100.8
Average height, L (mm)	51.6	51.7	51.7	51.9	51.8	51.8
Cross-sectional Area, A (m^2)	8.03×10^{-3}	7.85×10^{-3}	7.85×10^{-3}	7.84×10^{-3}	7.90×10^{-3}	7.98×10^{-3}
Permeability Hydraulic gradient across samples i=30/L (m head of water/m)	581	580	580	578	579	579
Constant Flow Rate, Q (cc/hr)	0.03216	0.03449	0.03630	0.01579	0.01474	0.01714
m^3/sec	8.93×10^{-12}	9.58×10^{-12}	1.01×10^{-12}	4.39×10^{-12}	4.09×10^{-12}	4.76×10^{-12}
Coefficient of Permeability, k (m/sec)	1.91×10^{-12}	2.10×10^{-12}	2.22×10^{-12}	9.69×10^{-13}	8.94×10^{-13}	1.03×10^{-12}
Average Coefficient of Permeability, k (m/sec)	2.08×10^{-12}			9.64×10^{-13}		
Comparative Ratio	0.46					

7/15/1997	**REPORT NO.: B 20297/BSB/2B**					
	Setsco Services PTE LTD					
	Comparative Test for Water Permeability on Plain Grade 30 Concrete Against Concrete Applied with Penetron Cementitious Capillary Waterproofing System (slurry).					
Permeability Test at 3.0 kg/cm^2						
Sample References	Control			Treated' with Penetron Cementitious Capillary Waterproofing System Slurry		
	C1	C2	C3	T1	T2	T3
Dimensional Measurement Avg. Diam. (mm)	101.1	100.0	100.0	101.2	101.2	100.9
Average height, L (mm)	51.6	51.7	51.7	53.4	52.5	53.6
Cross-sectional Area, A (m^2)	8.03×10^{-3}	7.85×10^{-3}	7.85×10^{-3}	8.04×10^{-3}	8.03×10^{-3}	8.00×10^{-3}
Permeability Hydraulic gradient across samples i=30/L (m head of water/m)	581	580	580	562	571	560
Constant Flow Rate, Q (cc/hr)	0.0321625	0.0344875	0.0363020	0.02037	0.01938	0.01897
m^3/sec	8.93×10^{-12}	9.58×10^{-12}	1.01×10^{-11}	5.66×10^{-12}	5.38×10^{-12}	5.26×10^{-12}
Coefficient of Permeability, k (m/sec)	1.91×10^{-12}	2.10×10^{-12}	2.22×10^{-12}	1.25×10^{-12}	1.17×10^{-12}	1.17×10^{-12}
Average Coefficient of Permeability, k (m/sec)	2.08×10^{-12}			1.20×10^{-12}		
Comparative Ratio	0.58					

TOXICITY TESTING

12/26/1984	FDRL STUDY NO. 8375A/TEST ARTICLE ID: 84-0909
	Food and Drug Research Laboratories, Inc.
	Acute Oral Toxicity of Penetron in Sprague-Dawley Rats
	Result: According to 16 CRF 1500, Penetron is not considered to be toxic and does not require cautionary labeling

6/5/1997	REPORT NO: B20297/EL/4
	Setsco Services PTE LTD
	Cytotoxicity Test on Penetron Cementitious Capillary Waterproofing Systems
	Results: The product shall be regarded as being suitable for contact with water intended for human consumption as it exhibits a 'non-cytotoxic' response when in contact with Vero ceels.

9/2/1999	REPORT: 981660CH90088
	Materialab Limited
	Report on Analysis of Coating Material: Non Toxicity Test (Migration of Toxic Elements)
	Results: The submitted test sample complied with the test requirement of BS 5665: Part 3 1995 for toxic element content.

1/00/2001	REPORT: GB 17219-1998
	Department of Toxicology, Beijing Municipal Centers for Disease Prevention & Control
	Standard for Safety Evaluation of Equipment and Protective Materials in Drinking Water System
	Results: The mouse oral toxicity test revealed results of LD_{50}>10000 mg/kg body weight concluding that the test article is actual nontoxic. From the results of the testing, Penetron showed no evidence of clastogenic activity when administrated orally in this vivo test procedure, thus the micronucleus test of the bone marrow cell is negative. The result of the Ames test is also negative both in the absence and presence of S9 mix.

6/28/2004	REPORT: 2004KL0620
	Sirim QAS International Sdn. Bhd.
	BS 6920: Part 1:2000 (Suitability of Non-Metallic Product for Use in Contact with Water Intended for Human Consumption with Regard to Their Effect on the Quality of the Water)
	Results: The sample tested complied with all the requirements of BS 6920: Part 1:2000; Clause 5, 6 & 8

X-RAY ANALYSIS TESTING

1/24/1995	REPORT NO. 95-387
	Shimel and Sor Testing Laboratories, Inc., Cedar Grove, NJ
	Laboratory Testing of Penetron Waterproofing Systems
	Results: Calcium accumulation in concrete below the Penetron coating to 25-50 mm depths. Calcium appears to be in the form of $Ca(OH)_2$ and calcium-silicate gel. Crystalline growths are the diffusion products of the components of the Penetron coating on the concrete surface. Below 50 mm depths, Ca(OH) is less while the silica content from cement becomes dominant. Penetron coated concrete surfaces develop improved concrete microstructure and waterproofing properties.

ПЕНЕТРОН АДМИКС ИСПЫТАНИЯ

ОПРЕДЕЛЕНИЕ ВОДОНЕПРОНИЦАЕМОСТИ

07/05/2003	**ОТЧЕТ №22/26**			
	Лаборатория ОАО ПТО «ПРОГРЕСС», г.Екатеринбург			
	Определение водонепроницаемости бетонных цилиндров-образцов с добавкой Пенетрон Адмикс			
	Испытания проводились по ГОСТ 12730.5-84 по методу «мокрого пятна» на образцах-цилиндрах 15х15см. Водонепроницаемость бетона оценивалась максимальным давлением воды, при котором на 4-х из 6-ти образцов не наблюдалось просачивания воды.			
Результаты испытаний				
	Контрольные образцы		Образцы с добавкой Пенетрон Адмикс	
Марка бетона	300		300	
Возраст бетона, дн.	28	60	28	60
Марка по водонепроницаемости	W-4	W-4	W-6	W-8

25/10/2004	**ОТЧЕТ №19/64,65**	
	Лаборатория ОАО ПТО «ПРОГРЕСС», г.Екатеринбург	
	Определение водонепроницаемости конструктивного бетона производства ООО «Новоуральский бетонный завод» с добавкой Пенетрон Адмикс	
	Испытания проводились по ГОСТ 12730.5-84 по методу «мокрого пятна» на образцах-цилиндрах 15х15см. Водонепроницаемость бетона оценивалась максимальным давлением воды, при котором на 4-х из 6-ти образцов не наблюдалось просачивания воды.	
Результаты испытаний		
	Конструктивный бетон	Конструктивный бетон с добавкой Пенетрон Адмикс
Марка бетона	300	300
Возраст бетона, дн.	101	101
Марка по водонепроницаемости	W-4	W-8

01/09/2005	**ОТЧЕТ №19/120,121**	
	Лаборатория ОАО ПТО «ПРОГРЕСС», г.Екатеринбург	
	Определение водонепроницаемости конструктивного бетона производства ООО «3 ЖБИ и К на Автомагистральной» с добавкой Пенетрон Адмикс	
	Испытания проводились по ГОСТ 12730.5-84 по методу «мокрого пятна» на образцах-цилиндрах 15х15см. Водонепроницаемость бетона оценивалась максимальным давлением воды, при котором на 4-х из 6-ти образцов не наблюдалось просачивания воды.	
Результаты испытаний		
	Конструктивный бетон	Конструктивный бетон с добавкой Пенетрон Адмикс
Марка бетона	300	300
Возраст бетона, дн.	37	37
Марка по водонепроницаемости	W-2	W-8

05/06/2007	**ОТЧЕТ №19/138**	
	Лаборатория ОАО ПТО «ПРОГРЕСС», г.Екатеринбург	
	Определение водонепроницаемости конструктивного бетона с добавкой Пенетрон Адмикс	
	Испытания проводились по ГОСТ 12730.5-84 по методу «мокрого пятна» на образцах-цилиндрах 15х15см. Водонепроницаемость бетона оценивалась максимальным давлением воды, при котором на 4-х из 6-ти образцов не наблюдалось просачивания воды.	
Результаты испытаний		
	Конструктивный бетон	Конструктивный бетон с добавкой Пенетрон Адмикс
Марка бетона	300	300
Возраст бетона, дн.	32	38
Марка по водонепроницаемости	W-2	W-8

08/10/2007		
	МУП «Казметрострой», Центральная производственно-строительная испытательная лаборатория, г.Казань	
	Определение водонепроницаемости бетона с добавкой Пенетрон Адмикс	
	Испытания проводились по ГОСТ 12730.5-84 по методу «мокрого пятна» на образцах-цилиндрах 15х15см. Водонепроницаемость бетона оценивалась максимальным давлением воды, при котором на 4-х из 6-ти образцов не наблюдалось просачивания воды.	
Результаты испытаний		
	Контрольные образцы	Образцы бетона с добавкой Пенетрон Адмикс
Класс бетона по прочности	B15	B15
Возраст бетона, дн.	28	28
Марка по водонепроницаемости	W-2	W-6

12/11/2007 **ОТЧЕТ 9747**		
	Белорусский Национальный Технический Университет (БНТУ), г.Минск	
	Определение водонепроницаемости бетона с добавкой Пенетрон Адмикс	
	Испытания проводились по ГОСТ 12730.5-84 «Бетоны. Методы определения водонепроницаемости (по мокрому пятну) на образцах-цилиндрах 15х5см. Водонепроницаемость бетона оценивалась максимальным давлением воды, при котором на 4-х из 6-ти образцов не наблюдалось признаков фильтрации воды.	
Результаты испытаний		
	Контрольные образцы	Образцы бетона с добавкой Пенетрон Адмикс
Марка по водонепроницаемости	W-2	W-10

ОПРЕДЕЛЕНИЕ МОРОЗОСТОЙКОСТИ

08/10/2007		
	МУП «Казметрострой», Центральная производственно-строительная испытательная лаборатория, г.Казань	
	Определение марки по морозостойкости бетона с добавкой Пенетрон Адмикс	
	Испытания проводились по ГОСТ 10060.2	
Результаты испытаний		
	Контрольные образцы	Образцы бетона с добавкой Пенетрон Адмикс
Класс бетона по прочности	B15	B15
Возраст бетона, дн.	28	28
Марка по морозостойкости	F 100	F 200

PENETRON ADMIX TEST REPORTS

ABSORPTION TESTING

12/1/2002	**ACCI REF. NO.: 58324**
	University of New South Wales: Australian Centre for Construction Innovation
	Properties of Type GP Cement Concrete Modified with Penetron Admix
	Testing Water Absorption and AVPV (AS 1012.21) and Water Sorptivity (RTA Test Method T362)
	Results: See Table 4.4-1 The concrete Mix-P containing Penetron Admix had both slightly lower water absorption and AVPV values than the control concrete Mix-C. See TAB Water Sorptivity (RTA Test Method T362) has been used by RTA (NSW) as an assessment test for quality assurance in the RTA QA Specification B80 for Concrete Works for Bridges. The test results clearly shown that the use of Penetron Admix in Concrete Mix-P resulted in a reduction of the water penetration depth to 60% of that of the control concrete Mix-C. Also, the water penetration depths of both concretes are much less than the maximum permitted depth of 25 mm for the exposure classification B1 and 35 mm for the exposure classification A required in the RTA (NS) QA Specification B80.

TABLE 4.4-1 WATER ABSORPTION AND AVPV (AS 012.21)		
Test Item	Mix-P	Mix-C
Water Absorption	6.35%	6.48%
Apparent Volume of Permeable Voids	14.35%	14.88%

TABLE 4.5-1 WATER SORPTIVITY PENETRATION DEPTH (RTA-T362)		
Test Item	Mix-P	Mix-C
Water Sorptivity Penetration Depth (RTA-T362)	10.2	16.4

12/1/2003	**ACCI REF. NO.: J#61707**
	The University of New South Wales: The Australian Centre for Construction Innovation
	Testing Properties of a commercial Concrete Mix Modified with Penetron Admix
	Results: The water absorption and the apparent volume of permeable voids (AVPV) in hardened concrete were tested according to AS 1012.21. According to the acceptance criteria of VICROADS based on AVPV for concrete in various exposure classifications, the acceptable AVPV value for exposure classification B1 and B2 is less or equal to 15% and 14% respectively. Penetron Admix modified concrete satisfied both criteria. Exposure classification B2 is a described in AS3600 as such "permanently submerged in sea water" and the classification B1 includes several exposure environments less aggressive than B2.

TABLE 3		
Water Absorption	6.00%	
Apparent Volume of Permeable Voids	13.62%	

AIR CONTENT TESTING

12/01/06	**ACCI REF. NO. 58324 – AIR CONTENT**
	The University of South Wales
	The Australian Centre for Construction Innovation – Properties of Type GP Cement Concrete Modified with Penetron Admix
	Results: The air content of fresh concrete in Mix-P was measured to be 1.7%, which was lower than that of 3% in the control mix and which was measured according to AS 1012.4.2. A lower air content generally results in denser concrete and may influence compressive strength

CHEMICAL RESISTANCE TESTING

12/01/05	**ACCI REF.NO. 58344 – LENGTH CHANGE IN SULPHATE SOLUTION (AS 2350.14)**
	The University of New South Wales: The Australian Centre for Construction Innovation
	Properties of Type GP Cement Concrete Modified with Penetron Admix
	Results: Expansion of the samples of the two concretes are shown in Table 4.8-1. Proposed assessment criteria of the AS 2350.14 test for acceptable sulphate resistance is that the expansion should be no more than 900 microstrains after 16 weeks immersion in the sulphate solution. Expansions of samples of the concrete Mix-P and Mix-C in this test were less than 600 microstrains or less than two thirds of the expansion limit of the proposed criteria. The expansion of the samples of Mix-P was slightly higher than that of the control mix Mix-C. The difference is not very significant and test results may have been influenced by the much higher slump (130 mm) of Mix-P compared with that of Mix-C (80 mm).

Table 4.8-1 EXPANSION IN MICROSTRAIN									
Immersion Time (week)	0	2	4	6	8	10	12	14	16
Mix-P	0	106	165	224	271	334	419	489	591
Mix-C	0	69	139	176	218	295	345	386	463

8/31/2006	**REPORT NO.: 2004A102007**
	Shanghai Research Institute of Building Sciences
	Chemical Resistance of Penetron Admix Modified Mortar after soaked in various chemical solutions for 60 days.
	Results: Penetron Admix mortars were observed to have better resistance to chemicals than control mortars.

CHLORIDE RESISTANCE TESTING

12/01/02	**ACCI REF.NO.58324 – CYCLIC CHLORIDE PENETRATION (ACCI METHOD)**
	The University of New South Wales: The Australian Centre for Construction Innovation
	Properties of Type GP Cement Concrete Modified with Penetron Admix
	Results: After 14 days cyclic exposure in 15% salt solution and drying at 40ºC show the Chloride Penetration Depth (mm) to be 19.7 for Mix-P and 26.6 for Mix-C. The ACCI accelerated chloride penetration test demonstrated at 35% reduction in the accelerated chloride penetration depth with the use of Penetron Admix in concrete Mix-P compared to the control concrete Mix-C.

8/31/2004	**REPORT NO.: 2004A102007**
	Shanghai Research Institute of Building Sciences
	Chloride Ion Penetration of Concrete: Hardened Concrete: Accelerated Chloride Penetration
	Chloride Ion Diffusion Coefficient of Concrete
	Results: Chloride ion diffusion coefficient can directly indicate penetration velocity of chloride ions through the concrete specimens. Penetron Admix could significantly reduce the passage of chloride containing solutions and improve concrete compactness. Penetron Admix modified concrete had a 30.8% reduction at 90 days when compared to control concrete with similar slump.

10/10/2005	**REPORT NO. 05-4070A**
	Sor Testing Laboratories, Inc., Cedar Grove, NJ
	Laboratory Tests of Penetron Admix in Concrete
	Results: As per AASHTO-T 277, Penetron Admix treated concrete showed very low chloride permeability with 750 charges passed/coulombs. The control concrete showed high chloride permeability with 4130 charges passed/coulombs.

3/29/2006	**REPORT NO.: 06-1918**
	Sor Testing Laboratories, Inc., Cedar Grove, NJ
	Laboratory Testing of Penetron Admixture As Per NCHRP-244 Methods
	Results: As per the requirements of the National Cooperative Highway Research Program Report 244, there was considerable reduction in the chloride content in the specimens treated with the Penetron. The reduction in chloride absorption by weight percent were.

Treatment	Reduction
Penetron Treated	89.7
Treated (Exposed to UV)	89.1
It was noted that exposure to ultraviolet light had only a minor effect on the chloride absorption. In the control specimens, the depth of chloride penetration was very high at 0-1 inch depths and rather considerable at 1-2 inch depths. In the treated samples, chloride penetrations were measurable but not high at 0-1 inch depths. While at the 1-2 inch depths, the chloride penetrations were minimal. It is concluded from these test results that treating concrete with Penetron Admixture at the rate studied reduced considerably (at least 89%) the amounts of chloride penetrations to a concrete depths of 1 inch and practically eliminates the penetration of chlorides to depths beyond 1 inch.	

CHLORIDE (CL-) ION CONTENT OF CONCRETE CUBES AFTER 21-DAYS SOAKING IN 15% NACL SOLUTION (*) (**)		
Type of Treatment	Chloride Ion Content % by Weight of Concrete	
	0-1 Inch Depth	1-2 Inch Depth
Control (Untreated)	0.244	0.021
Control (Untreated) Exposed to UV Light	0.246	0.021
Penetron Treated	0.023	0.004
Penetron Treated (Exposed to UV Light)	0.024	0.005

* The background chloride content of the concrete was 0.001%. All results were corrected by subtracting the background value from the chloride results.
** All test results are the average of triplicate tests.

WATER ABSORPTION AFTER SOAKING IN 15% NACL SOLUTION FOR 21 DAYS	
Type of Treatment	Weight, Gain % (*)
Control (Untreated)	2.89
Control – Untreated (Exposed to UV Light)	2.92

Penetron Treated	0.57
Penetron Treated (Exposed to UV Light)	0.60

* 0-2 inch depth

5/1/2006	REPORT NO.: 06-3241		
	Sor Testing Laboratories, Inc., Cedar Grove, NJ		
	Shrinkage, Modulus, Resistance to Chlorides & Creep Test of Penetron Admixture Treated Concrete		
Resistance to Chloride Penetration			
Age, days	Depth, inches	Chloride (CI) Contents (*)	
		mg/kg	Ibs./cu yard
60	0.0625 to 0.50 0.50 to 1.0	37 24	0.14 0.09
90	0.0625 to 0.50 0.50 to 1.0	42 26	0.16 0.10

(*) the dry unit weight of the concrete was 3915 Ibs./cu. yard.

COMPRESSIVE STRENGH TESTING

01/05/1998	REPORT NO.: B22906/DJ/1
	Setsco Services PTE LTD
	Determination of compressive strength, water absorption, water permeability and scanning electronic Microscopic (SEM) Examination on concrete cubes treated with Penetron Admixture
	Results: According to BS 1881: Pt 166: 1993

TABLE 1: COMPRESSIVE STRENGTH									
Sample Reference	Concrete treated with Penetron Admix								
Specimen Reference	1	2	3	4	5	6	7	8	9
	150								
	01/12/97								
	08/12/97			15/12/97			29/12/97		
	7			14			28		
	34.0	34.0	33.5	38.0	38.5	38.5	41.0	41.5	41.5
	34.0			38.5			41.5		

01/22/1998	**REPORT NO.: B22906/DJ/2**
	Setsco Services PTE LTD
	Determination of compressive strength on concrete cubes treated with Penetron Admixture
	Result: According to BS 1881: Pt 166: 1993

TABLE 1: COMPRESSIVE STRENGTH			
Sample Reference	Concrete treated with Penetron Admix		
Specimen Reference	1	2	3
Size Of Cube (mm)	150		
Date Of Cast	01/12/97		
Date Of Test	26/01/98		
Age At Test (days)	56		
Compressive Strength (N/mm^2)	45.0	43.0	44.0
Average Compression Strength (N/mm^2)	44.0		

05/31/2001	**REPORT NO.: A3747/WCW**
	Setsco Services PTE LTD
	Report on Performance Assessment of Penetron Waterproofing Admixture
	Results: The compressive strength of concrete cubes made and tested at 28 days averaged 47.50 N/mm^2. The 7 days strength averaged at 44.0 N/mm^2. In some cases, there were little gain in strength from 7 to 28 days and in others, the gain was as much as 14%. The average 7 and 28 days compressive strength of the control concrete was 41.5 and 46.0 N/mm^2 respectively. The figures show that the admixture did not have any adverse effect on the strength of the concrete.

09/01/02	**ACCI REF. NO.: 58036**
	The Australian Centre for Construction Innovation; University of New South Wales
	An Investigation of Plastic and Other Early Age Properties of a Concrete Containing Penetron Admix
	Results: The compressive strength of the Mix-PX at age 3 days was 1.37 times that of the control mix Mix-CT. At the age of 7 days the compressive strength of Mix-PX was 1.30 times that of the control. The addition of Penetron Admix into concrete increased the early concrete strength significantly.

TABLE 2: TEST RESULT OF CONCRETE AT 3 AND 7 DAYS

Test Item	Mix-CT (Admix)	Mix-PX (Control)
Compressive Strength at 3 Days	23.0 MPa	16.7 MPa
Compressive Strength at 7 Days	31.4 MPa	24.2 MPa
SSD Density at 7 Days	2372 kg/m^3	2341 kg/m^3

12/01/02	**ACCI REF. NO. 58324**
	The Australian Centre for Construction Innovation; University of New South Wales
	Properties of Type GP Cement Concrete Modified with Penetron Admix
	Compressive Strength at 3,7,28 and 91 days (AS 1012.9) Results: Cylinder specimens were cast from both Mix-P and Mix-C concrete batches. The specimens were initially cured in moulds and covered with wet Hessian in temperature-controlled room at 23º C. They were removed from the moulds approximately 24 hours after casting and then cured in a limewater tank at 23º C. The compressive strength was tested in cylinder specimens according to the AS 1012.9. The compressive strength of the Mix-P was 1.22 to 1.37 times that of the control Mix-C at ages between 3 days to 91 days despite the slump of Mix-P (130 mm) being much higher than that of Mix-C (80 mm). It was apparent that the use of the Penetron Admix in concrete significantly increased the concrete strength. The increase in compressive strength by the Penetron Admix was proportionately greater at the early ages of 3 and 7 days. An important benefit of the rapid early strength gain is to permit striping of formwork earlier and to speed up the construction process. In the comparison of compressive strength of two concretes, it was reported in Section 4.1 that the air content in the fresh concrete Mix-P would be expected to contribute to its higher compressive strength at all the ages form 3 to 91 days.

08/31/04	REPORT NO: 2004A102007
	Shanghai Research Institute of Building Sciences
	Research Report on Performance Improvement of concrete and Mortar treated with Penetron and Penetron Admix Compressive strength, flexural strength and tensile strength of concrete specimens according to China Standard.
	Results: Penetron Admix enhanced the workability and plastic properties of concrete by reducing the water demand. The addition of Penetron Admix increased compressive, flexural and tensile strengths, and significantly reduced chloride permeability when compared to control concrete with similar slump.

CRACK HEALING TESTING

12/1/2006	ACCI REF. NO. 58324 – AUTOGENOUS CRACK HEALING CAPACITY (ACCI METHOD)
	The Australian Centre for Construction Innovation; University of New South Wales
	Properties of Type GP Cement Concrete Modified with Penetron Admix
	Results: It was shown that both concretes had recorded reduced leakage rate through the crack in concrete samples. This is the so-called "autogenous crack healing" capacity of cement concrete due to further hydration of the unhydrated cement particles exposed in the crack zone. However, the Penetron Admix concrete Mix-P had shown significantly higher crack-healing capacity than the control concrete Mix-C. After 70 days exposure to moist atmosphere, the water leakage through the cracks in concrete Mix-P reduced by 73% while that in the control concrete Mix-C reduced by 35%. The greater crack-healing capacity of the concrete Mix-P appears to be primarily attributable to the crystallization mechanism of the Penetron Admix.

12/01/03	**ACCI REF. NO.: J#61707**
	The University of New South Wales: The Australian Centre for Construction Innovation
	Testing Properties of a Commercial Concrete Mix Modified with Penetron Admix
	Results: Drying shrinkage of the concrete was measured with three prism samples according to AS 1012.13. The monitoring of changes in the specimen length due to drying shrinkage was extended from the normal period of 56 days to 91 days.

TABLE 2. DRYING SHRINKAGE OF CONCRETE (AS 1012.13)								
Drying Age (day)	0	4	7	14	21	28	56	91
Drying Shrinkage (microstrain)	0	121	169	269	355	404	530	598

10/10/2005	**REPORT NO. 05-4070A**
	Sor Testing Laboratories, Inc., Cedar Grove, NJ
	Laboratory Tests of Penetron Admix in Concrete
	Results: As per NY DOT Method of 502-3P, the concrete specimens were subjected to a 3% sodium chloride solution in 25 cycles of freeze thaw. The Penetron Admix treated specimen showed good durability under severe freeze thaw conditions with an average of 0.74% weight loss opposed to the control specimen with a 4.97% weight loss.

PERMEABILITY TESTING

01/05/1998	**REPORT NO.: B22906/DJ/1**
	Setsco Services PTE LTD
	Determination of compressive strength, water permeability and scanning electronic Microscopic (SEM) Examination on concrete cubes treated with Penetron Admixture
	Results: DIN 1048: Pt 5: 1991

TABLE 2: WATER PERMIABILLITY TEST

Sample reference	Concrete treated with Penetron Admix					
Specimen reference	1	2	3	4	5	6
Date of cast	01/12/97					
Date of water pressure applied	08/12/97			30/12/97		
Age At Test (days)	7			29		
Water pressure applied (N/mm^2)	0.5					
Duration of test (hours)	72					
Depth of penetration (mm)	18.8	22.4	18.8	11.0	11.0	9.7
Average depth of penetration (mm)	20.0			10.6		

05/31/2001	**REPORT NO.: A3747/WCW**
	Setsco Services PTE LTD
	Report on Performance Assessment of Penetron Waterproofing Admixture
	Results: Penetron Admixture has evidently reduced the porosity and permeability even of a water tight control and laboratory prepared concrete without reducing the water cement ratio. The improvement is expected to be more pronounced in concrete of lower quality and concrete cast in-situ. The coefficient of water permeability of the treated concrete is in the range of 10^{-13} m/s. Based on the guidelines given in DIN 1045, the treated concrete complies with the requirements for water resistant/waterproof concrete.

12/1/2002	**Report: ACCI REF. NO. 58324**
	The Australian Centre for Construction Innovation, Properties of Type GP Cement Concrete Modified with Penetron Admix
	Water Permeability Test (ACCI Method)
	Results: According to a review of permeability test methods published by British Concrete Society, concretes with permeability coefficients below 1 x 10^{-12} are considered to be very good while concrete with permeability coefficient between 1 x 10^{-12} m/sec are considered to be acceptable.

TABLE 4.9-1 COEFFICIENT WATER PERMEABILITY (ACCI-METHOD)

Test Item	Mix-P (Treated Sample)	Mix-C (Control Sample)	Water Permeability Coefficient Reduction
Coefficient of Water permeability (m/sec)	1.76 x 10^{-12}	7.24 x 10^{-12}	Water Permeability Test (ACCI Method)

10/10/2005	**REPORT NO. 05-4070A**
	Sor Testing Laboratories, Inc., Cedar Grove, NJ
	Laboratory Tests of Penetron Admix in Concrete
	Results: As per ASTM-D 5084, the Penetron Admix treated concrete showed improvements of an average permeability of 2.45 x 10^{-10} cm/sec over the control (untreated) concrete of 3.66 x 10^{-8} cm/sec.

POLITECHNIKA KRAKOWSKA (TECHNICAL UNIVERSITY IN KRAKOW)	
	Testing Report of Concrete Additive Penetron Admix
	Results: Concrete with Penetron Admix I/I showed W28 (1.0MPa) and the control concrete I showed W8 (0.8MPa). Concrete with Penetron Admix II/I showed W30 (3.0MPa) to the control concrete II of W9 (1.4MPa)

SEM X-RAY ANALYSIS

05/31/2001	**REPORT NO.: A3747/WCW**
	Setsco Services PTE LTD
	Report on Performance Assessment of Penetron Waterproofing Admixture
	Results: The SEM-EDX analysis conducted on the treated concrete showed the presence of dendritic crystals, which are found in pores such as capillary tracts, shrinkage cracks and bleed water tracts that allow crystallization of the additional cementitious material. This clearly shows

	the crystallization effect of Penetron Admixture, which reduces and seals the pores in the concrete. This will effectively enhance the durability of the concrete by preventing ingress of water and chemicals that destroy the matrix of the cement hydrate.

10/25/2002	**REPORT NO.: A6127/CHF**
	Setsco Services PTE LTD
	Microscopic Analysis on the concrete Cores From Retaining Wall at Changi Airport Terminal 3
	Results: A lot of coarse-grained elongated crystals were seen lining the crack. All these crystals showed low birefringence under crossed polarized microscope. The coarse grained elongated crystal contained mainly Ca, O, Si. The fine-grained needle-like crystal was predominantly made up of Ca, Si, O, S, and Al, which was probably ettringite.

12/1/2002	**ACCI REF. NO.: J060673 & J061037**
	The University of New South Wales: The Australian Centre for Construction Innovation
	Microscopic Examination of Crystalline Products in Penetron Admix Modified Concrete Samples After a Crack Healing Test Result
	Results: The observation from a comprehensive SEM examination of the Penetron Admix modified Type GP concrete samples demonstrate significant evidence of a crystallization mechanism by which the Penetron Admix reacts with cement hydrates to form characteristic crystalline networks and effectively seal cracks in the modified concrete.

TABLE 1. CRACK HEALING CAPACITY (ACCI-METHOD)

Crack Healing Time (from Concrete Age 21 Days)	Relative Leakage Rate through Cracks in Penetron Modified Concrete (Mix-P)
0 Days	100%
21 Days	88%
70 Days	27%
151 Days	12%