



AquaProof® WB10

NEW WATER BASED WATER REPELLENT SYSTEM

AquaProof WB10 is a new emulsion concentrate system developed as a water based alternative to the solvent based water repellent treatment for wood and masonry commonly found in hardware and building material stores. It is composed of a 40% dispersion of the active ingredients (non-silicone) in water and an aqueous solution of a proprietary metal crosslinking agent. To produce a fully VOC compliant (0 VOC) trade sales product, formulators dilute AquaProof WB31A with water, add the AquaProof WB31B and adjust the pH with ammonia.

TRADE SALES PRODUCTS MADE WITH THIS SYSTEM HAVE THE FOLLOWING ADVANTAGES:

- VOC COMPLIANT – No organic solvent
- WATER-BASED PRODUCT
- INTERIOR OR EXTERIOR USE
- PENETRATING COLORLESS TREATMENT
- REDUCES WATER ABSORPTION AND SWELLING OF WOOD
- REDUCES WATER ABSORPTION OF MASONRY
- GOOD “BREATHING” PROPERTIES
- PRONOUNCED WATER BEADING EFFECT
- CAN BE SECOND-COATED

The major feature of this system is the crosslinking mechanism which locks the hydrophobic materials in the pores of the substrate. As a result, the dimensional stability (prevention of water absorption and water swelling) of wood treated with this system equals the performance of wood treated with the leading solvent-based products.

PHYSICAL PROPERTIES

The Two FedChem Products Needed For This System Are:

AquaProof WB31A Emulsion Concentrate

Appearance	White Heavy Liquid
Specific Gravity (25 °C)	0.95
Density	7.9 Pounds/Gal.
Active Material (solids)	39 – 41%
Flash Point (PMCC)	>200 °F
Organic Solvent	None

AquaProof WB31B Metal Catalyst Solution

Appearance	Clear to Hazy Liquid
Specific Gravity (25 °C)	1.2
Density	10.01 Pounds/Gal.
Active Material (solids)	Approximately 25%
Flash Point (PMCC)	>200 °F
Organic Solvent	None

FORMULATION

(Weight %)

Clear Formula:

20% AquaProof WB31A
10% AquaProof WB31B
70% Water
Ammonia to pH range 9.6 – 9.8

Procedure:

1. Add the water slowly to the AquaProof WB31A with slow mixing at ambient temperatures.
2. Add the metallic crosslinking agent (AquaProof WB31B) to the above mixture slowly with slow mixing.
3. Using ammonia (NH₄OH), raise the pH to a range of 9.6 – 9.8.

NOTE: The formulated product tends to separate into two layers upon standing overnight. Be sure to stir gently before application to substrate. Application directions below.

The above formula, without the addition of any other ingredients or additives, makes a waterproofing compound that complies with the ASTM D4446 standard for swelling of wood and Federal Specification SS-W-110C for water repellency on brick and masonry. Prior to making any deviation from this formula, please read the “ADDITIVES” section on Page 6.

The crosslinking agent has proven to be stable in the diluted compound. The above user strength formula has survived seven weeks in a 50°C oven without diminishing its performance properties. The pH adjustment in the formula provides an ammonia blocking mechanism which insures a long shelf life.

Application Directions:

Although the trade sales formula separates into two layers, it is easily redispersed by gentle mixing. A “Stir or Shake Gently Before Use” statement should be put on the label.

The product can be brushed, dipped, or spray applied to the wood surface. Although a degree of water repellency can be seen after 30 minutes, full repellency usually will take about 48 hours, depending somewhat on weather conditions. Unlike many other water repellents, this product can be over-coated to provide even greater protection. A second coat can be applied after a minimum drying period of 30 minutes, but no longer than 6 hours.

PERFORMANCE

The performance goal for the development of this system was for it to be as effective as the leading solvent-based products on wood substrates, both in water beading and water absorption properties. While products such as wax emulsions can provide a temporary beading effect, they usually provide very little protection against water absorption. Our year long exposure tests indicate that both beading and water absorption properties of our new water-based water repellent system are long lasting and compare favorably with the solvent-based standards.

TEST RESULTS

Federal Specification SS-W-110C for Masonry

<u>Test</u>	<u>Requirement</u>	<u>Results</u>	
		<u>Clay</u>	<u>Concrete</u>
Water repellency on Masonry Water Absorption, %	1.0 Max.	0.0%	0.4%

ASTM D4446 Standard for Swelling Wood

SWELLOMETER TEST DATA – SUMMARIZED (See Appendix for Full Data)

AquaProof WB10 System as produced

<u>Sample</u>	<u>Wet Weight</u>	<u>Dry Weight</u>	<u>% H₂O Pickup</u>	<u>Swell Reading</u>	<u>Swell Efficiency (60% Passes)</u>
Control	4104	2616	57	398	0
AquaProof WB10	2921	2750	6	104	74

AquaProof WB10 System after 7 weeks in 50°C oven

<u>Sample</u>	<u>Wet Weight</u>	<u>Dry Weight</u>	<u>% H₂O Pickup</u>	<u>Swell Reading</u>	<u>Swell Efficiency (60% Passes)</u>
Control	4206	2646	59	397	0
AquaProof WB10	2983	2769	8	132	67

TEST RESULTS CONTINUED

Exposure Data – Wood (One Year)

Exposure studies were conducted comparing AquaProof WB10 water system with the solvent-based product and an untreated control. 3” x 6” wood blocks were prepared from pine, red cedar and 5-ply plywood. Single applications of the test materials were applied to the blocks, and after a suitable drying period, they were placed outdoors in Bethlehem, PA, facing south at 45° angles. After one year exposure, the results are as follows:

<u>Sample</u>	<u>Pine</u>		<u>Red Cedar</u>		<u>Plywood</u>	
	<u>Beading</u>	<u>% Abs.</u>	<u>Beading</u>	<u>%Abs.</u>	<u>Beading</u>	<u>%Abs.</u>
Untreated	POOR	11.6	POOR	21.1	POOR	36.9
Solvent Based	POOR	4.8	FAIR	4.9	GOOD	9.2
AquaProof WB10	V/GOOD	4.6	V/GOOD	3.4	V/GOOD	23.3

The new water-based formulation has retained most of its effectiveness after one year’s exposure. Its beading properties were judged to be overall best and the resistance to water absorption was equal to the solvent-based product in all but the plywood samples. Because of the presence of interlayer glues and the uneven nature of plywood edges, water-based products tend to be repelled and generally do not seal them well, even though AquaProof WB10 does a good job on the surface as evidenced by the Very Good beading rating.

APPEARANCE OF TREATED WOOD SUBSTRATES

The AquaProof system is not a film forming coating, but more of a treatment similar to many of the successful solvent-based waterproofing materials. Unlike some of the low VOC (water clean up) products that contain vinyl polymers that support mildew and bacteria growth, AquaProof WB10 completely disappears into the pores of the wood and does not provide a film to support the growth of spores. In fact, the metallic crosslinker tends to discourage microbial growth within the pores of the substrate. The net effect is the AquaProof WB10 treated wood turns gray naturally with age like untreated wood, but is free from excessive cracking and deterioration caused by the swell/shrink cycles of untreated wood.

With some woods there is a temporary discoloration caused by the tannin being brought to the surface by the basic pH of the AquaProof WB10 system. Wood varieties high in tannin such as redwood and red cedar are particularly susceptible to this phenomenon. However, this condition is only temporary. Since there is no film in which to entrap the tannin, it goes away within two or three weeks of normal exterior exposure.

ADDITIVES

Surfactants and dispersants usually found in additives for water-based systems have a detrimental effect on the water absorption properties of this system. **FOR THIS REASON, WE RECOMMEND AGAINST THE ADDITION OF ANYTHING WITHOUT FIRST DETERMINING ITS EFFECT ON THE WATER ABSORPTION OR SWELL PROPERTIES OF WOOD TREATED WITH THE FORMULA.** For example, the surfactants found in some pigment dispersions are quite detrimental to the swell and moisture pick up properties, since they tend to attract water rather than repel it. Also, the formula as shown on Page 3 of this bulletin contains No Volatile Organic Compounds. However, there may be some VOC added if you use any of the following in your product.

Pigments

FedChem recommends a line of transparent iron oxide pigment dispersions from Evonik Industries that are compatible with the AquaProof WB10 system, specifically, the Aqua-Chem 892-1054 and 892-1852 (red and yellow) series. Usage level should be between 1% and 4% by weight of the pigment dispersion depending on the deepness of the color desired.

Resins

Resins can be used in the AquaProof WB10 formulation to provide beneficial properties such as better rub off or abrasion resistance. Care must be taken when using acrylic type resins to ensure that no residual acrylic acid remains in the polymer. We have identified 2 resins that provide better rub-off characteristics to the formulation. These materials can be incorporated up to a maximum ratio of approximately 10:1 resin solids to pigment solids. An example of AquaProof WB10 Redwood Stain formulated with Carboset[®] CR-760, Evonik pigment dispersions, biocides, and defoamer is include in the Appendix.

- Rhodopas LSA-200 (Hexion): Styrene-acrylic emulsion
- Carboset[®] CR-760 (Lubrizol): Styrene-acrylic emulsion

Preservatives

All of our exposure testing so far has been with the formula as shown in this bulletin, without any additives. Tests have shown that the formula does not support microorganism growth, so no preservatives should be needed in the product. No mildew problems were encountered in exposures in Bethlehem, PA, and Manchester, England. If a biocide is desired in the formulation, we recommend Polyphase 663 and Polyphase 678 (Troy). These materials can be incorporated using approximately 0.2% by weight of the biocide.

Freeze/Thaw Protection

The user strength formula on Page 3 will be damaged by freezing unless it is protected by a small amount (0.5%) of propylene glycol. While this small amount of glycol won't stop it from freezing solid, it protects the particle size of the emulsion. The addition of 0.5% propylene glycol to the formula on Page 3 caused it to pass five freeze/thaw cycles when run by the ASTM D-2243 protocol. **IMPORTANT!** AquaProof WB31A (the emulsion concentrate) is not and cannot be made freeze/thaw stable, and will therefore have to be kept from freezing. AquaProof WB31B (the catalyst solution) on the other hand, is not harmed by freezing.

Defoamers

Slow speed mixing at ambient temperatures is all that is necessary for making up the formulation. High shear dispersers can be used if they are run at moderate speeds. Production equipment constraints, such as high pressure can filling equipment, may necessitate the use of a defoamer. Defoamers are usually high in surfactant content and therefore cannot be used indiscriminately in this formula. A laboratory test program to determine how the defoamer affects moisture absorption properties should be run before a defoamer type and level is chosen. We have identified two defoamers that do an excellent job without much effect on the swell properties if the use level is kept below 0.5%. These are Troykyd D-729 (Troy) and Cognis Foamaster WBA (Cognis).

APPENDIX

SWELLOMETER TEST DATA ASTM D4446 Standard for Swelling of Wood

AquaProof WB10

<u>Sample</u>	<u>Wet Weight</u>	<u>Dry Weight</u>	<u>% H₂O Pickup</u>	<u>Swell Reading</u>	<u>Swell Efficiency (60% Passes)</u>
47A3	3107	2950	5	92	77
50A3	2841	2663	7	122	70
56A3	3063	2906	5	90	78
57A3	2778	2614	6	91	74
59A3	2817	2615	<u>8</u>	127	<u>69</u>
Average			6		74

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<u>Sample</u>	<u>Wet Weight</u>	<u>Dry Weight</u>	<u>% H₂O Pickup</u>	<u>Swell Reading</u>	<u>Swell Efficiency</u>
47B3	4271	2851	50	408	0
50B3	4140	2555	62	409	0
56B3	4464	2701	65	412	0
57B3	3763	2417	56	351	0
59B3	3882	2557	<u>52</u>	410	<u>0</u>
Average			57		0

AquaProof WB10 (After 7 weeks at 50°C)

<u>Sample</u>	<u>Wet Weight</u>	<u>Dry Weight</u>	<u>% H₂O Pickup</u>	<u>Swell Reading</u>	<u>Swell Efficiency (60% Passes)</u>
47A4	3165	2978	6	118	71
50A4	2911	2672	9	150	63
56A4	3164	2958	7	118	71
57A4	2816	2620	7	115	68
59A4	2858	2618	<u>9</u>	161	<u>60</u>
Average			8		67

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<u>Sample</u>	<u>Wet Weight</u>	<u>Dry Weight</u>	<u>% H₂O Pickup</u>	<u>Swell Reading</u>	<u>Swell Efficiency</u>
47B4	4260	2862	49	405	0
50B4	4207	2546	65	400	0
56B4	4673	2755	70	413	0
57B4	4031	2557	58	363	0
59B4	3861	2510	<u>54</u>	404	<u>0</u>
Average			59		0

APPENDIX continued

AquaProof WB10 Fully Formulated Redwood Stain

<u>Sample</u>	<u>Wet Weight</u>	<u>Dry Weight</u>	<u>% H₂O Pickup</u>	<u>Swell Reading</u>	<u>Swell Efficiency (60% Passes)</u>
14A1	3063	2890	6	76	80
14A2	2691	2563	5	57	86
14A3	3283	3098	6	61	82
14A4	2680	2505	7	74	77
14A5	2986	2791	<u>7</u>	65	<u>81</u>
Average			6		81

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<u>Sample</u>	<u>Wet Weight</u>	<u>Dry Weight</u>	<u>% H₂O Pickup</u>	<u>Swell Reading</u>	<u>Swell Efficiency</u>
14B1	4450	2799	59	380	0
14B2	4360	2643	65	405	0
14B3	4735	3055	55	337	0
14B4	4135	2476	67	320	0
14B5	4312	2875	<u>50</u>	340	<u>0</u>
Average			59		0

LEADING SOLVENT BASED PRODUCT

<u>Sample</u>	<u>Wet Weight</u>	<u>Dry Weight</u>	<u>% H₂O Pickup</u>	<u>Swell Reading</u>	<u>Swell Efficiency (60% Passes)</u>
12A1	3083	2880	7	95	74
12A2	2799	2599	8	126	69
12A3	3301	3089	7	101	71
12A4	2736	2530	8	82	73
12A5	2998	2804	<u>7</u>	137	<u>64</u>
Average			7		70

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<u>Sample</u>	<u>Wet Weight</u>	<u>Dry Weight</u>	<u>% H₂O Pickup</u>	<u>Swell Reading</u>	<u>Swell Efficiency</u>
12B1	4499	2829	59	365	0
12B2	4302	2613	65	408	0
12B3	4684	3015	55	347	0
12B4	4186	2498	67	300	0
12B5	4285	2855	<u>50</u>	385	<u>0</u>
Average			59		0