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Chemical Resistance of Ultra-Repair Putty

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SUMMARY

Ultra-Repair Putty was immersed in the chemicals listed below to determine the effects of exposure to these chemicals on two key physical properties. The following chemicals were chosen to study:

- Pure Water
- Hydrochloric Acid 30%
- Sulfuric Acid 30%
- Nitric Acid 50%
- Caustic Soda (NaOH 20%)
- Caustic Soda (NaOH 50%)
- Acetone
- Diesel
- Ethanol
- Gasoline
- MEK
- Mineral Spirits
- Toluene
- Xylene

The two physical properties that were studied were hardness and compressive strength. Hardness is a measure of how much a material resists indentation by a sharp cone and is an indication of the strength of its surface. Compressive strength is a measure of how much stress a material can withstand before breaking and is an indication of its internal strength.

From the testing detailed below, it was found that Ultra-Repair Putty is very resistant to Diesel Fuel, Toluene, and Caustic Soda. Ultra-Repair Putty was aggressively attacked by acetone and concentrated nitric acid, as both chemicals destroyed the test specimens before the end of the experiment.

It is worth noting that changes in strength do not necessarily correlate to fitness of use. For example, Ultra-Repair Putty has only a moderate resistance to pure water, but is certified by NSF for use in potable water repairs. It is recommended that any potential end user use the information presented below to complement their own application data when determining if Ultra-Repair Putty is fit for their specific end use.

EXPERIMENT

Sample specimens of Ultra-Repair Putty were made by casting nominal 0.5” x 0.5” x 1” prisms using a PTFE mold. The prisms were allowed to cure for 2 weeks at ambient laboratory temperatures before the chemical exposures began.

Fourteen 150 mL beakers were filled with each chemical listed. Initial measurements of each samples were recorded (weight, length, depth, width, and hardness) and then immersed in their corresponding beakers. The samples were evaluated by removing the samples from volatile chemical solutions and letting solutions evaporate from the sample. Samples in non-volatile chemical solutions were rinsed in water and dried prior to recording measurements. Samples were evaluated at the 1, 7, 30 and 60 day intervals. At the 7, 30, and 60 day intervals, selected specimens of the dried samples were also evaluated for compressive strength. The specimens that were not tested for compressive strength were returned to the appropriate beakers.

Hardness was measured in accordance to ASTM D2240. A model 307L hand held durometer by PTC instruments was used to make all measurements. For each reading, the durometer was pressed into the surface of the sample for five seconds, and the hardness was read off of the instrument and recorded. A total of 3 readings were taken for each measurement and the average value was recorded.

Compressive Strength was measured in accordance to ASTM D695. A H25KS universal testing frame with a 5000 pound-force load cell manufactured by Tinius Olsen was used to test the sample specimens and record the resulting stress and strain at break. Specimens were tested between two parallel plates at a cross-head speed of 0.05 inches per minute. The results of each test were recorded.

In the case of both hardness and compressive strength, a set of control specimens were cured and not exposed to any chemical. The average values for the specimens exposed to each chemical were compared to the average value of the control group tested at the same time. The data present below as the percent ratio of the experimental results to the control.

DATA AND RESULTS

HARDNESS

		Days Exposed			
CATEGORY	**Chemicals**	**1**	**7**	**30**	**60**
WATER					
	Pure Water	100%	76%	85%	84%
SOLVENT					
	Xylene	100%	99%	98%	99%
	Mineral Spirits	100%	100%	99%	99%
	Diesel	99%	96%	97%	97%
	Toluene	100%	99%	95%	90%
	Gasoline	101%	91%	84%	83%
	Ethanol	97%	84%	58%	51%
	MEK	102%	76%	47%	45%
	Acetone	103%	58%	40%	0%
CAUSTIC					
	Caustic Soda 50%	99%	99%	100%	99%
	Caustic Soda 20%	100%	97%	97%	96%
ACID					
	Sulfuric Acid 30%	99%	88%	57%	50%
	Hydrochloric Acid 30%	90%	55%	40%	49%
	Nitric Acid 50%	104%	36%	0%	0%

COMPRESSIVE STRENGTH

Category	Chemical	Days Exposed 7	30	60
WATER				
	Pure Water	84%	35%	52%
SOLVENT				
	Diesel	103%	83%	106%
	Xylene	77%	75%	82%
	Toluene	112%	72%	75%
	Gasoline	50%	52%	60%
	Mineral Spirits	62%	43%	58%
	MEK	51%	14%	24%
	Ethanol	42%	12%	17%
	Acetone	31%	14%	0%
CAUSTIC				
	NaOH (50%)	109%	86%	76%
	NaOH (20%)	97%	76%	72%
ACID				
	Sulfuric Acid	48%	40%	42%
	Hydrochloric Acid	32%	29%	13%
	Nitric Acid	42%	0%	0%

Graphical forms of this data is presented in Appendix A.

CONCLUSION

The data presented above demonstrates that Ultra-Repair Putty can be used as part of an emergency repair even when exposed to a wide variety of chemicals. After contact with the most aggressive substance tested (50% Nitric Acid) for 24 hours Ultra-Repair Putty retained 90% of the initial surface hardness.

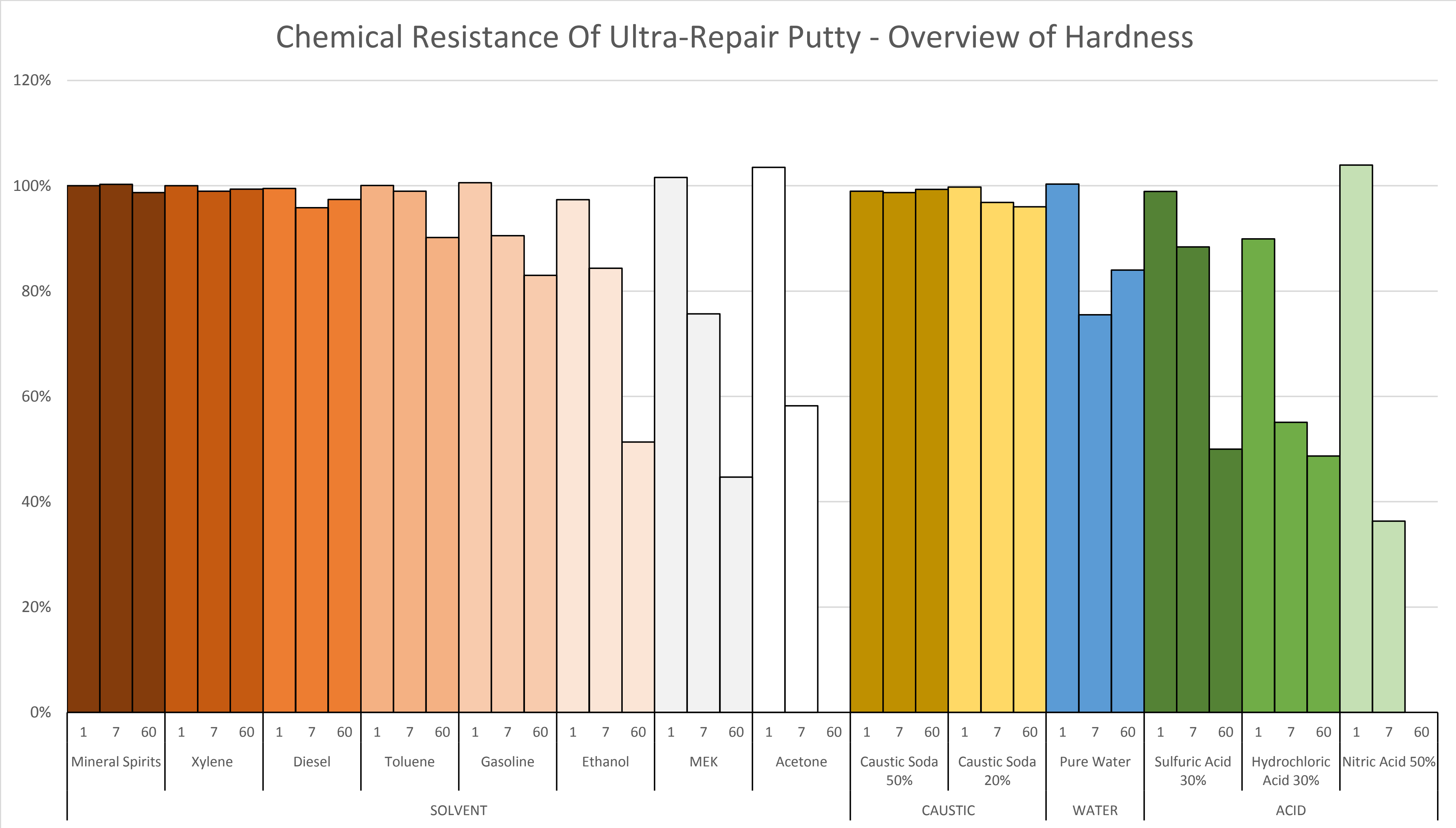
The data also demonstrates that long term continuous exposure to some chemicals will degrade the cured product. The exact rate of this degradation will vary depending on the chemical. Concentrated organic acids and short chain alcohols and ketones have the most effect on the product over time. Conversely aromatic solvents, diesel fuel, and aqueous caustic solutions have a minimal effect on cured Ultra-Repair Putty. In the case of gasoline, a consumer fuel grade was chosen which incorporates up to 10% ethanol. This blend showed a moderate effect on the product.

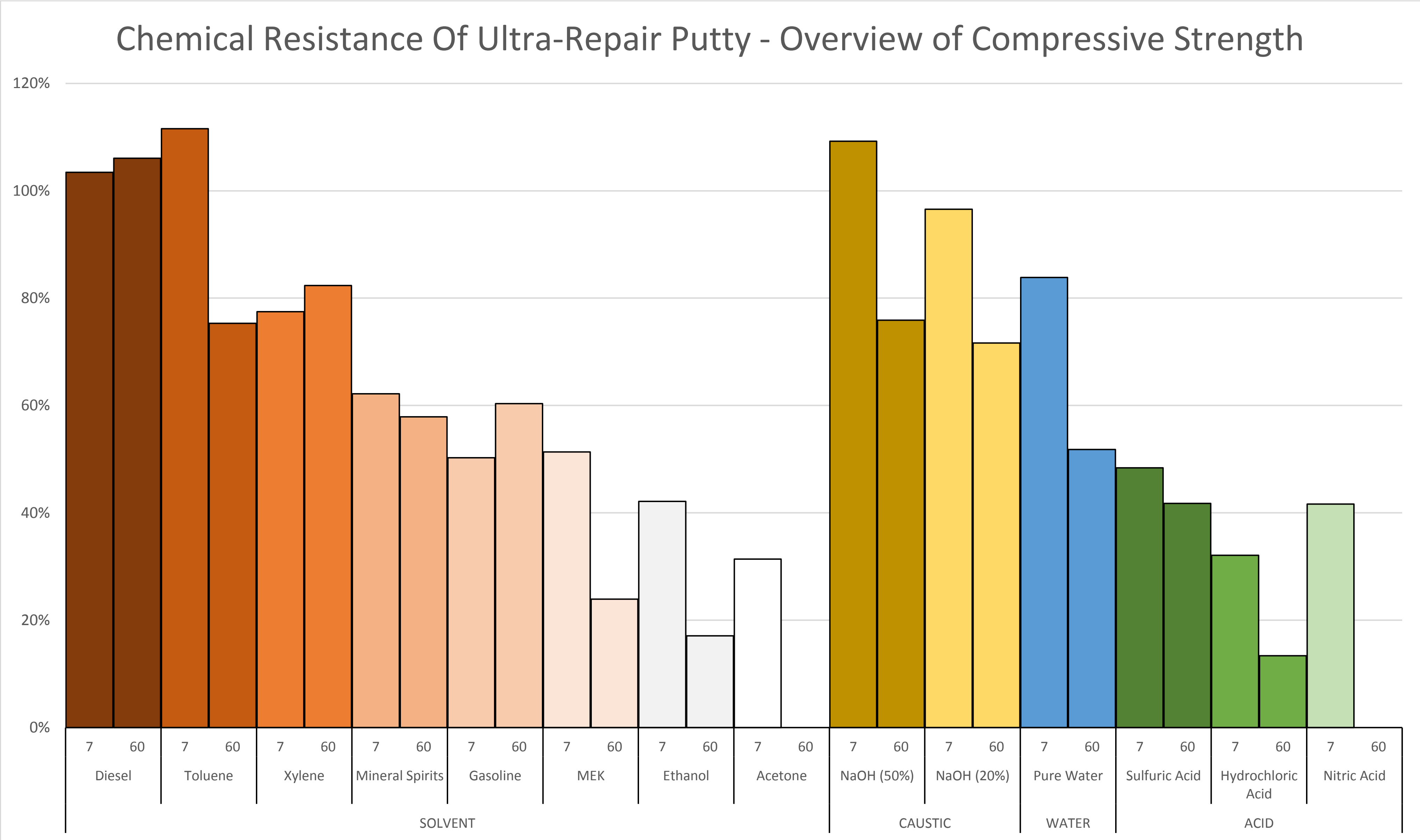
The data presented above was generated on samples that were completely submerged in the substances under investigation. In many field applications, only one surface of the product is exposed to a chemical. It these applications, the hardness data may be an appropriate indicator of expected performance. For applications where Ultra-Repair Putty is mostly submerged, the compressive strength data is expected to be more relevant.

Studying chemical resistance under total immersion for 60 days is a severe test. Many chemical resistance validation testing protocols, including those used by Underwriter's Laboratory, use vapor exposures instead of liquid immersion. It is expected that chemical vapors will degrade Ultra-Repair Putty slower and to a lesser degree than shown above.

In all cases this data is provided to aid in the specification and design of repair systems. It is recommended that for safety critical applications, a full risk assessment be conducted before any repair is put into service.

APPENDIX A – HARDNESS AND COMPRESSIVE STRENGTH GRAPHS





Chemical Resistance Of Ultra-Repair Putty - Overview of Compressive Strength
120%
100%
80%
60%
40%
20%
0%
7
60
Diesel
Toluene
Xylene
Mineral Spirits
Gasoline
MEK
Ethanol
Acetone
NaOH (50%)
NaOH (20%)
Pure Water
Sulfuric Acid
Hydrochloric Acid
Nitric Acid
SOLVENT
CAUSTIC
WATER
ACID