



Concrete Pump Primers

Performance Characteristics and Evaluation

Fritz-Pak Corporation
11220 Grader St. STE 600
Dallas, TX 75238
USA
214-221-9494

Prepared by:
Gabriel Ojeda
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Introduction

After extensive research and testing, synthetic pump primers were introduced worldwide in the early 90's. Four U.S. patents have been awarded to Slick-Pak and Slick-Pak II for their novel chemistry and application.¹

Since the introduction of our products, other primers have entered the market. The purpose of this report is to explain the characteristics and performance that primers should have and also to compare Slick-Pak and Slick-Pak II with other commercially available products.

Why prime concrete lines?

A typical concrete mix is shown in Table 1. As you can see, the water content of a typical mix is less than 7%. Even though the concrete looks wet, the water content is very low. When you start pumping, if you do not use a primer, water from the concrete will be used to wet the inner surface of the pipeline. As the concrete keeps going through the pipeline, more and more water will be lost until eventually the leading edge of the concrete will be dry and form a plug. This situation will worsen if the pipeline has leftover dry concrete residue that absorbs more water than clean pipe. Additionally, you can lose water through the joints in the pipeline. Therefore, in order to minimize the loss of water to wet the pipeline, pump primers are used.

Table 1: Composition of typical concrete		
Component	Weight (lbs)	Percentage
Water	262	6.83%
Cement	625	16.29%
Coarse aggregate	1675	43.65%
Fine aggregate	1275	33.23%
Total	3837	100.00%

Water can be used to prime short runs of pipeline. However, water is very thin, and it can run only on the lower portion of the pipeline. It does not lubricate the complete pipeline circumference, and the wet coating left by water is much thinner than that left by pump primers. In addition, water can wash the cement paste from the concrete leading edge and create a plug of aggregates.

Viscosity

Viscosity refers to the thickness of a material and its ability to flow. Materials like honey, cooking oil, mayonnaise, ketchup and molasses are considered thick, while water, alcohol, gasoline and diesel are considered thin.

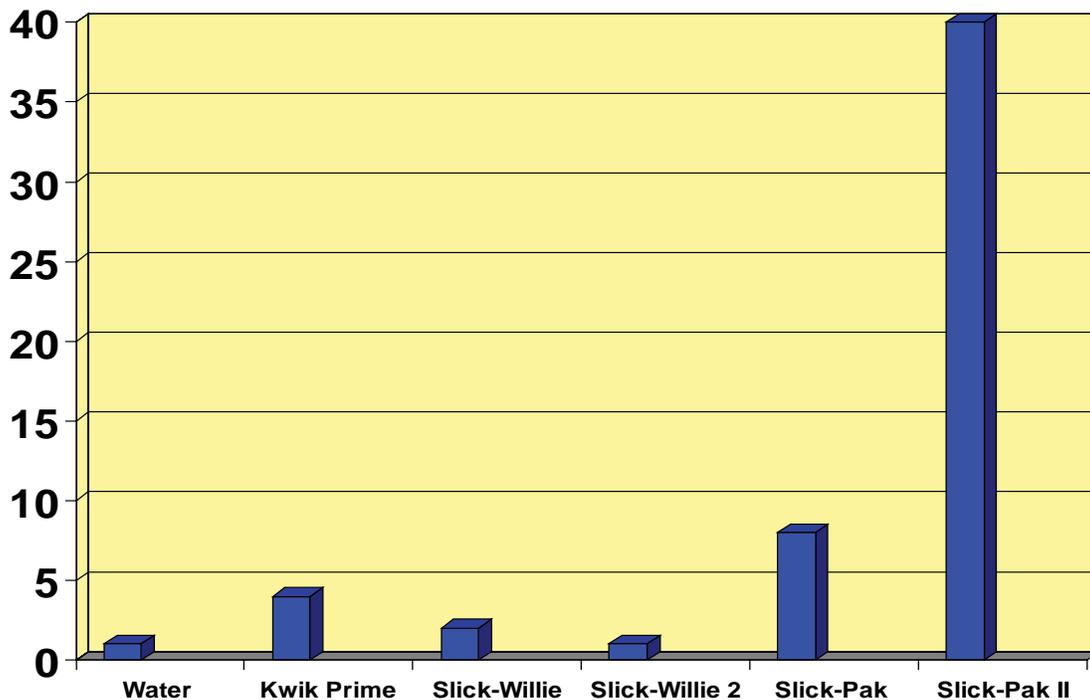
Why is viscosity important in concrete pump primers? The function of a primer is to coat the inner surfaces of pipes and hoses. If the coating is thin, there will not be enough material to keep the concrete wet, or to prevent it from losing water and/or cement paste.

Furthermore, thick materials run down more slowly than thin materials. This is important in priming because a thin material will run very fast on the lower part of a pipe when the concrete is flowing on a steep incline. If the material is thick, it cannot run down and will be pushed by the concrete. As it is pushed, it will be able to coat a wider area than when it is running freely on the lower part of the pipe.

A good analogy for pump primers is paint. If the paint coating is thin, you will need several coats to cover a surface. Additionally if the paint is thin, it will run more freely when painting on walls or vertical surfaces. Good paint needs to be thick enough to keep it from running and to create a good coat with a single application. The same can be said of good pump primers.

In order to determine the viscosity of Slick-Pak and other concrete primers² available in the United States, samples were sent to an independent lab³ (CSI Technologies) and viscosity tests were conducted using a Fann Viscometer. The results of the tests are in Graph 1.

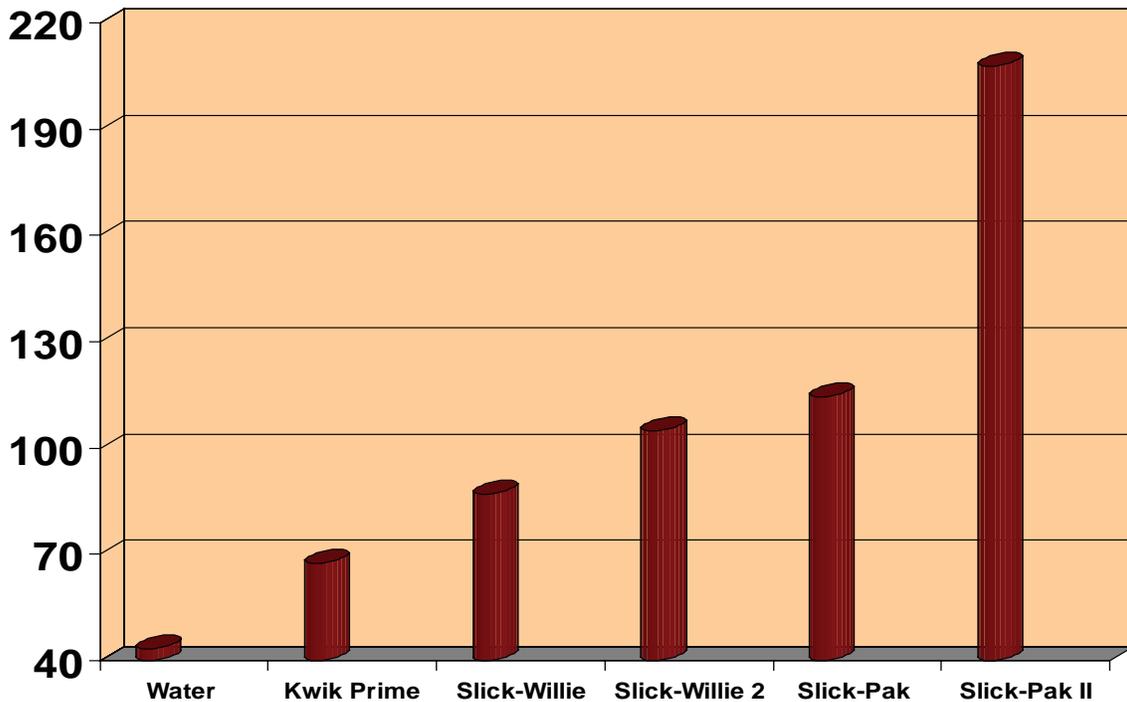
Graph 1: Relative Viscosity of Primers*



**Relative viscosity was calculated from the viscosity observed in a Fann 35 viscometer at 300 rpm spindle speed after mixing the products with de-ionized water for 5 minutes following API procedures.*

In addition to the viscosity test, we conducted tests to determine the amount of material that would coat a piece of steel pipe commonly used in concrete pumping. The amount of material in the coats was determined by subtracting the weight of a pipe that had been submerged in the primer and let drip for 10 seconds and the weight of a dry pipe. The amount of the coating was then calculated and expressed in grams per 10 ft of 5" diameter pipe to standardize the measurements. The results are presented in Graph 2.

**Graph 2: Coating weight produced by primers on steel pipe
(grams/10ft 5" pipe)**



From the pipe coating results you can see a correlation between the viscosity and the amount of coating. So it is possible to say that the higher viscosity material creates a better coating of pipes and hoses.

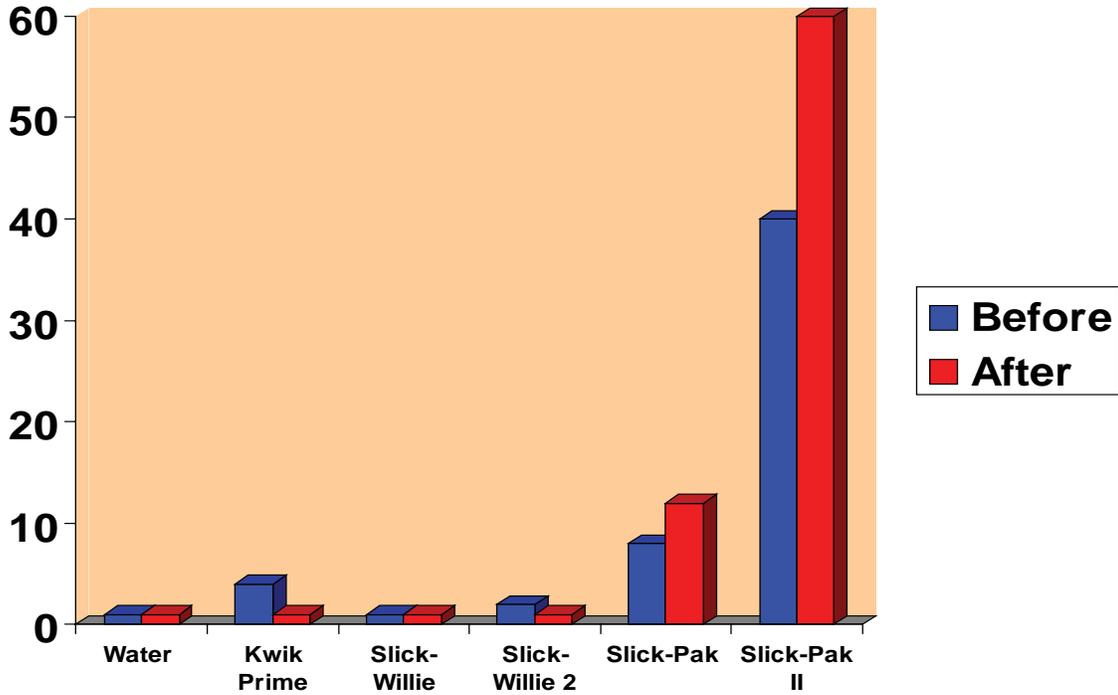
Tolerance to Concrete

Cement is a very alkaline material, and fresh concrete has a large amount of dissolved salts prior to the concrete hardening. It is the combination of dissolved salts and high alkalinity that makes fresh concrete a hostile environment for chemicals. Any pump primer must be able to tolerate being exposed to concrete or cement without breaking down. The same way you would expect a waterproof material to withstand water, or a fireproof material to withstand fire, a concrete pump primer must be able to withstand the alkalinity of concrete.

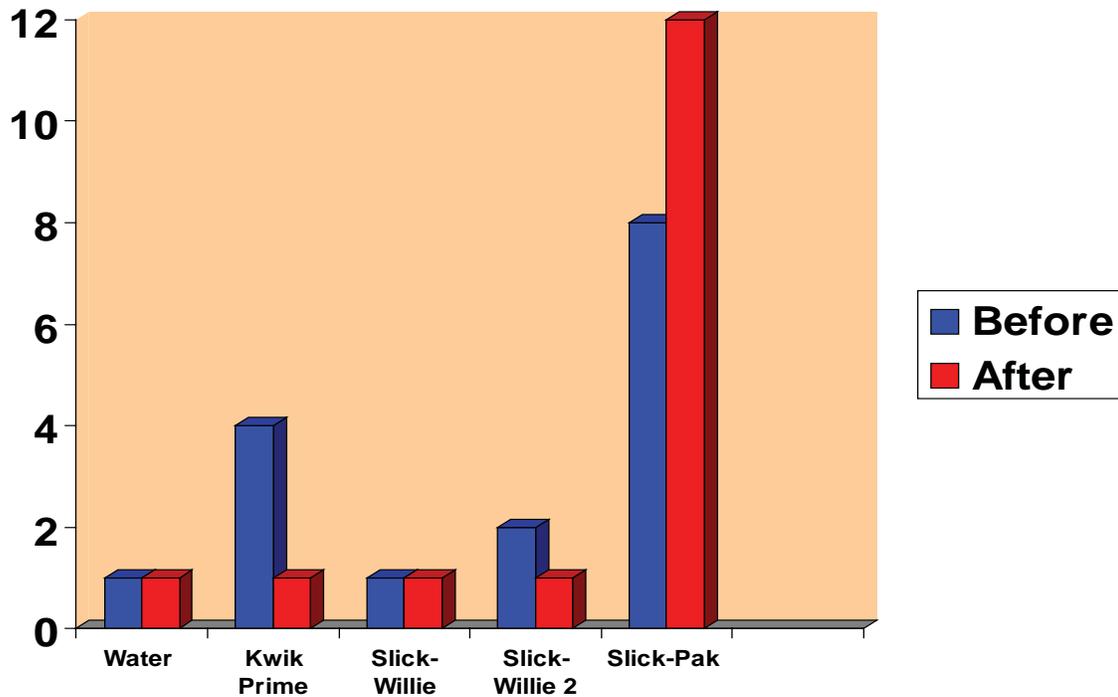
This is important because pump primers are mixed with tap water, and they may appear viscous or thick when initially mixed. But as the primers travel through the pipes, hoses, and even the hopper, they are exposed to concrete and cement residue. If a pump primer breaks down when exposed to these elements, what good is it?

In order to evaluate their ability to withstand concrete, the pump primers were mixed with water having the same pH and alkalinity of concrete and their viscosity was measured again. The results of these tests are presented in Graphs 3 & 4.

Graph 3: Relative viscosity of pump primers when mixed with cement water.⁵



Graph 4: Relative viscosity of pump primers when mixed with cement water (Slick-Pak II excluded to show breakdown).

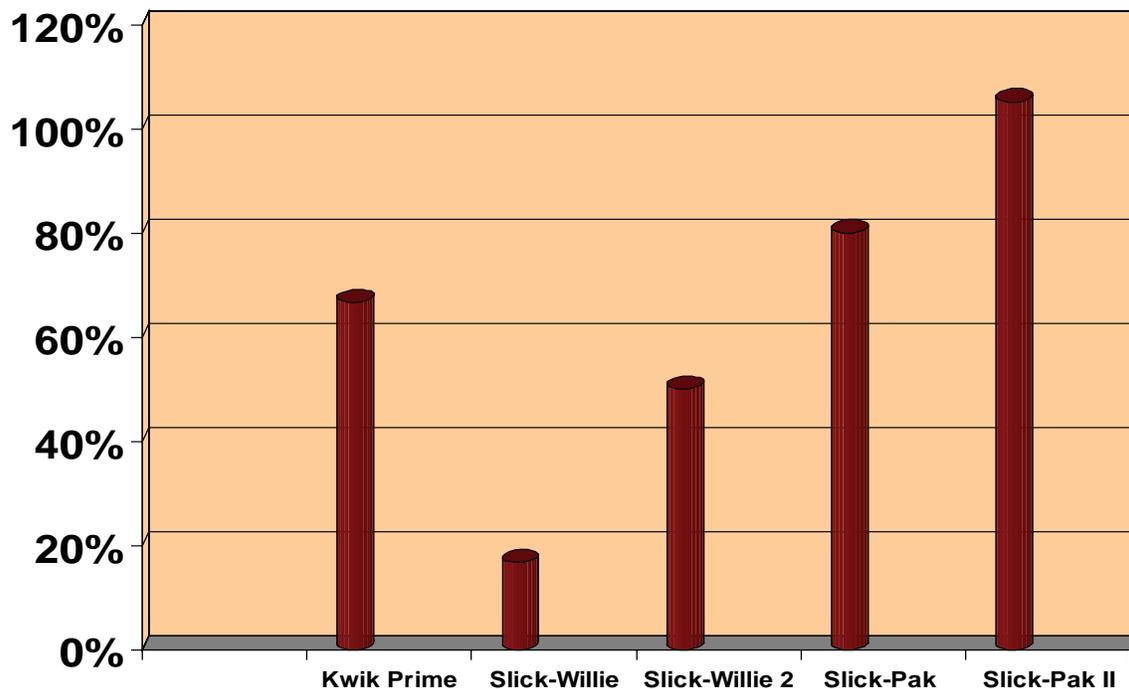


The results show that Kwik Prime and Slick-Willie 2 are not resistant to concrete since more than 75% and 50% respectively is lost after exposure to comparable levels of pH found in concrete. Slick-Willie was not affected, and both Slick-Pak and Slick-Pak II gained viscosity when exposed to the same levels.

Preparation Time

Synthetic primers are made with water-soluble materials that need to absorb water in order to develop their thickness. How fast should a primer be ready? We believe that a primer should be ready in less than 5 minutes. Under normal operating conditions, a pump operator can have more than 5 minutes to let a primer hydrate. However, there are many situations where more than 5 minutes are not available. Having to wait on the job should never be the fault of the pump primer. Therefore, we also tested the hydration speed of the primers to see which one was the fastest. In order to test the hydration speed of the primers, viscosity was measured at 5 and 30 minutes after adding water. Results of the tests are shown in Graph 5.

Graph 5: Viscosity development in 5 minutes



Conclusions

Products introduced in the market to compete with Slick-Pak and Slick-Pak II are not better. The products Kwik-Prime and Slick-Willie 2 should not be considered as primers since they lose more than half of their viscosity when exposed to concrete.

While Slick-Willie is resistant to concrete, it takes too long to be ready. In 5 minutes, less than 17% of its viscosity had developed; it needs an extensive amount time to make ready.

None of the three competing products achieve the viscosity and pipe coating capabilities of Slick-Pak and Slick-Pak II.

Notes:

- 1) United States Patents covering Slick-Pak and Slick-Pak II are 5,587,012, 5,443,636, 5,997,633 and 5,683,503.
- 2) The products Slick-Pak and Slick-Pak II are manufactured by Fritz-Pak Corporation. The products Slick-Willie, Slick-Willie 2 and Kwik-Prime are manufactured by Prima-a-Pac Corporation.
- 3) Tests of viscosity, time to prepare and viscosity when exposed to concrete were performed by CSI Technologies of Houston, Texas.
- 4) Tests of coating of pipe were conducted by Fritz-Pak Corporation at their laboratory.
- 5) Cement water refers to a solution made with 10% cement then filtered. This solution simulates the pH and alkalinity of concrete.