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Technical Data

SETSIT[®] Accelerator Activated Liquid Dithiocarbamate Accelerators

Most people in the latex industry are familiar with **BUTYL NAMATE[®]** Accelerator (NaDBC). It is recognized as the liquid alternative to **BUTYL ZIMATE[®]** Accelerator (ZDBC), the industry's water-insoluble, workhorse accelerator. Unfortunately, some people are unaware of the fact that this is not the only water-based alternative. There is a whole world of chemistry that deals with activated liquid dithiocarbamate accelerators for latex, and as complicated as the chemistry may be, it is not what distinguishes these products. They are instead distinguished by their performance and flexibility in latex compounds.

The **SETSIT** line of liquid dithiocarbamates includes water-miscible or water-soluble ultra accelerators. This means that in both natural and synthetic latexes, these products promote rapid cures, providing a rate and state of cure that is comparable to **BUTYL ZIMATE**. These products are extremely easy to use since they do not require dispersion or emulsification. They are also freeze/thaw stable, which eliminates shipping concerns over the winter months.

The Study

Because the various **SETSIT** accelerators were designed for specific applications, there are often subtle differences in their activity in latex. For this study Natural Rubber Latex (NRL) was selected. Synthetic latexes, while generally slower to cure than NRL, are expected to respond to these accelerators in a relative manner. The base compound for this study is as follows:

Table 1: The Base Compound

	WET (phr)
62% High Ammonia Natural Rubber Latex	161.0
10% Potassium Hydroxide	5.0
5% Potassium Caseinate	10.0
50% Sulfur Dispersion	2.0
50% Zinc Oxide Dispersion	6.0
50% AGERITE[®] STALITE[®] Antioxidant	2.6
Accelerator	Variable

Please note that this formula is written in wet phr rather than the usual dry phr. This is because the exact concentration of **SETSIT** accelerators is considered proprietary. The compounds were mixed without the use of any surfactants due to the fact that in some cases tensile strengths are lower when these are used. The compounds were cast on glass plates, air dried, stripped, oven dried, and cured in a circulating hot air oven for 20 minutes at 93.3°C (200°F). The films were then tested following the standard 24 hour ASTM waiting period.

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Optimum Accelerator Levels

Determining the optimum accelerator level was the first step in this study. Using the base compound given in Table 1, ranges of each of the accelerators were used and vulcanized for 20 minutes at 93°C. These films were then tested on a T-10 Tensiometer, and the results were plotted on a graph in order to determine the maximum tensile strength. Although not always considered optimal due to aging considerations, the amount of accelerator used to achieve a maximum tensile strength will be considered the optimal accelerator level.

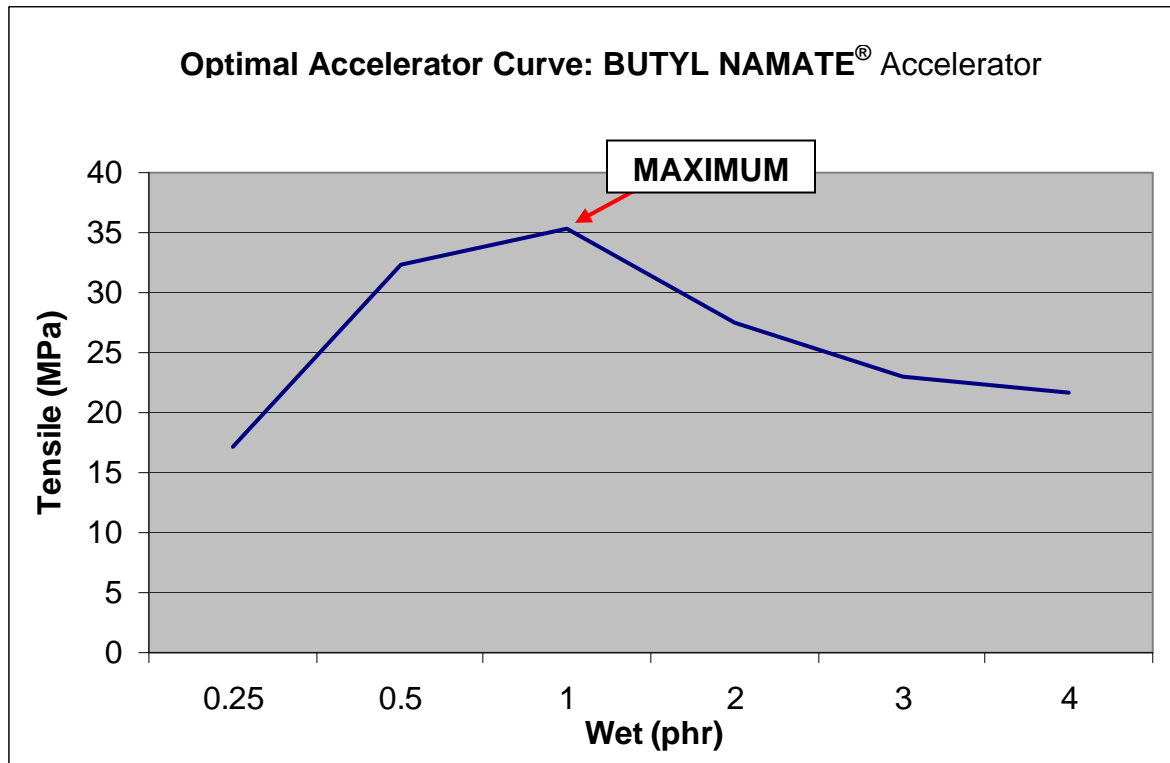


Figure 1: BUTYL NAMATE Optimal Accelerator Level

For **BUTYL NAMATE®** Accelerator, it is easy to determine the optimal accelerator level since there is a clear maximum tensile strength.

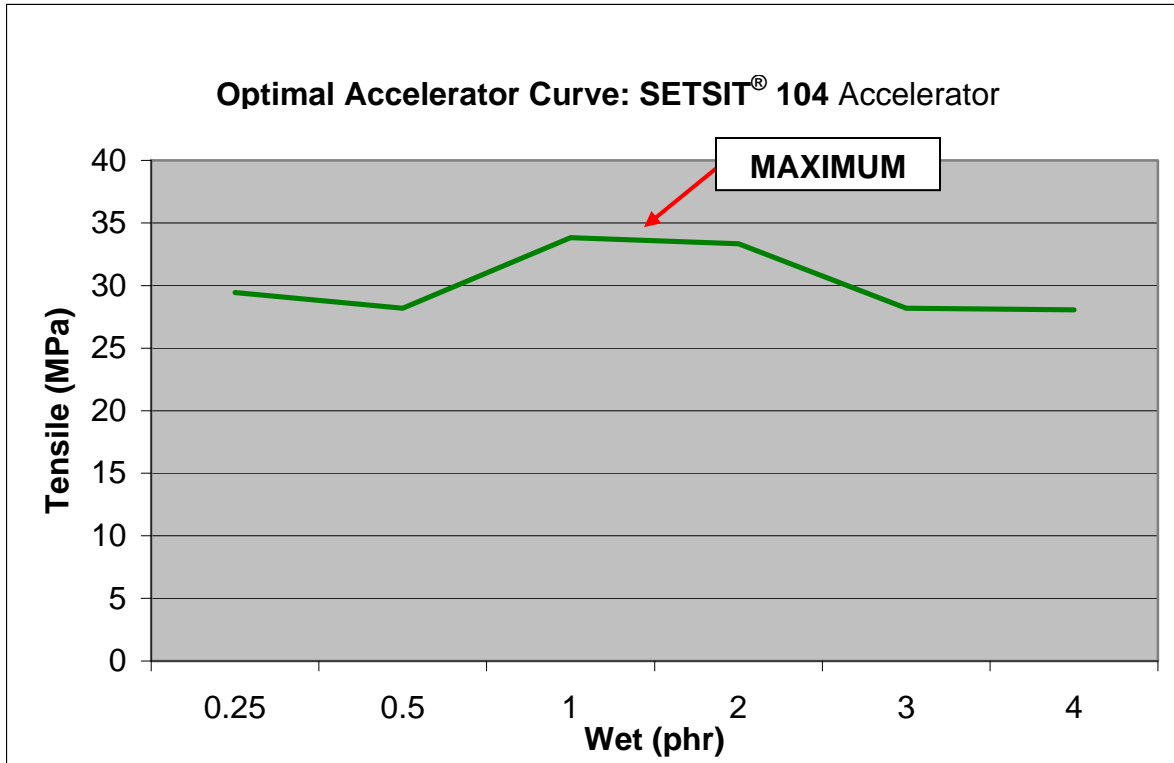


Figure 2: SETSIT 104 Optimal Accelerator Level

For **SETSIT® 104** Accelerator, it is not as easy to determine the maximum tensile strength. Since the results for 1 phr and 2 phr are essentially equivalent, it is safe to assume that the optimal accelerator level is somewhere between these two levels.

Instead of displaying similar figures for each individual accelerator, Table 2 summarizes the optimum and acceptable range for each of the accelerators.

Table 2: Optimum Accelerator Levels

Accelerator	Optimum Accelerator Level	Acceptable Range
BUTYL NAMATE® Accelerator	1.0	0.5 – 2.0
SETSIT® 5 Accelerator	1.5	1.0 – 4.0
SETSIT 104	1.5	0.25 – 4.0
SETSIT 055	1.5	0.5 – 3.0
SETSIT 981	2.0	1.0 – 6.0
BUTYL ZIMATE® Accelerator	2.0	0.5 – 3.0

Room Temperature Curing

For this evaluation, samples were coated as above, but rather than placing the films in a circulating hot oven for vulcanization, the films were allowed to cure over a period of time at room temperature. Room temperature is generally recognized as 72°F (22.2°C). By allowing the samples to vulcanize at room temperature, their relative speed will be determined. Each sample was made with 1 phr wet of accelerator.

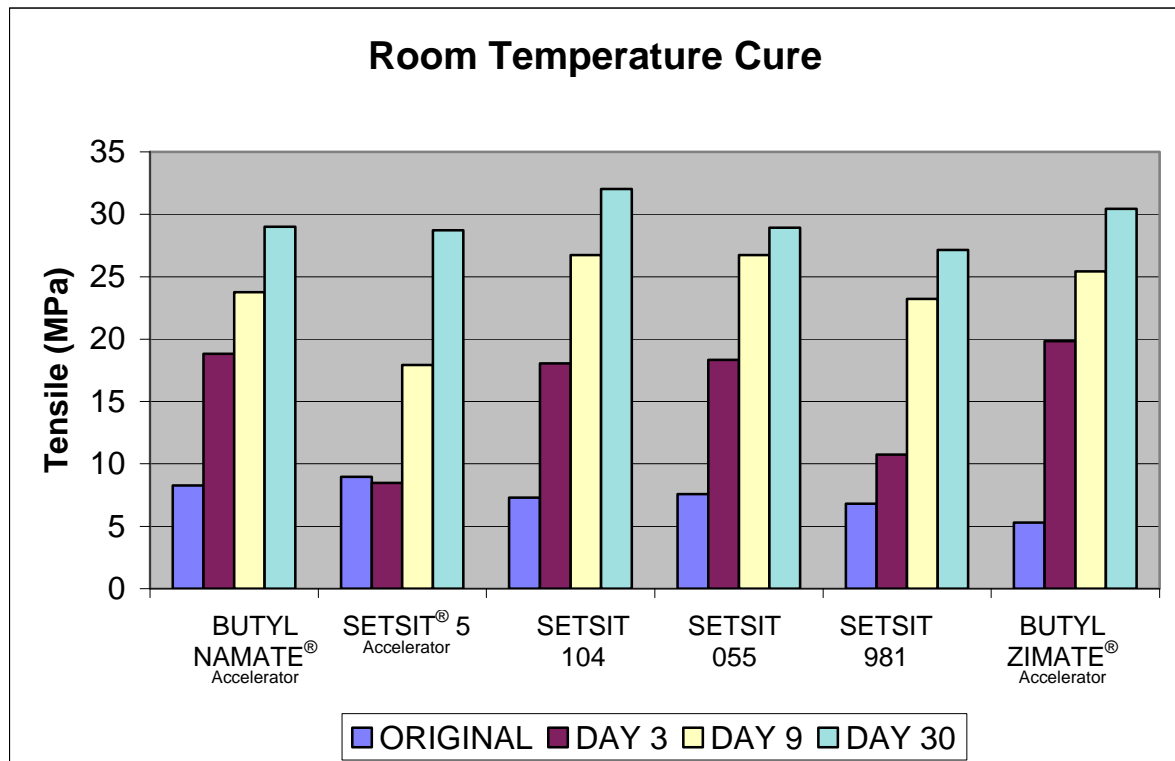


Figure 3: Room Temperature Cure

It is clear from this chart that all of the accelerators produce a similar state of cure originally and after 30 days. The differences are seen at 3 days and 9 days. After 3 days at room temperature, four of the samples have already exceeded 14 MPa (**BUTYL NAMATE®** Accelerator, **SETSIT® 104** Accelerator, **SETSIT 055**, and **BUTYL ZIMATE®** Accelerator). These accelerators have a faster rate of cure than the other two accelerators (**SETSIT 5** and **SETSIT 981**).

The Five Minute Cure

So far it has been shown that all of the accelerators included in this study will cure a latex film at room temperature and in a circulating oven, which demonstrates that vulcanization is not a static process. The next logical step in this study was to look at what happens when a combination of room temperature and hot air vulcanization is used.

The Five Minute Cure was devised to answer this question. Instead of curing the latex films for 20 minutes at 93°C, they were cured for only 5 minutes at 93°C. The films were then kept at room temperature for 30 days, and were tested periodically to note any increase in the state of cure as time passed. These films were made using the Optimum Accelerator Level shown in Table 2.

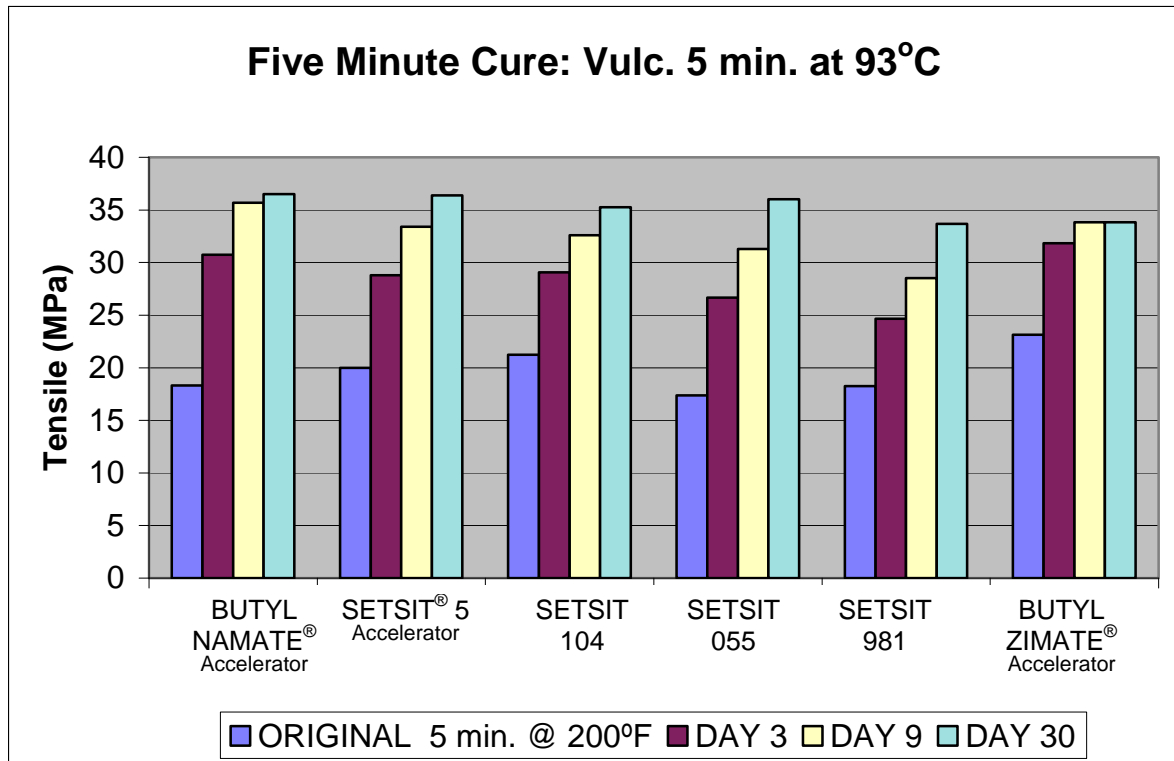


Figure 4: The Five Minute Cure

Figure 4 shows that the Five Minute Cure gives us the best of both worlds. After only 9 days at room temperature, the state of cure is comparable to a full oven cure of 20 minutes at 93°F. This saves 15 minutes on the cure cycle, which not only increases production speeds, but decreases the use of energy. Given the ever-increasing cost of production, the Five Minute Cure in combination with the use of the **SETSIT**[®] Accelerator product line is a great way to save money.