Avoid the Methylene Blue Blues

One of the sand tests vital to your plant’s success is also one of the most controversial in the industry.

Shea Gibbs, Senior Editor

The debate that ensued when 24 metalcasters and scientists got together for a meeting two years ago surprised Sarah Joyce, vice president of quality and technology at Badger Mining Corp., Berlin, Wis., and chairperson of the industry sand committee that was hosting the discussion.

“It was one of the more lively meetings we’ve ever had,” she said.

The discussion was about a seemingly niche topic that amounts to a few pages in a several hundred page textbook: the methylene blue sand test. The procedure is important—it determines the amount of live clay in a metalcaster’s sand system, a significant number since some of the clay in any system becomes dead (it can’t take on any additional moisture) after repeated use and sacrifices mold strength—but it’s only one of six tests experts recommend metalcasters perform on their sand systems on a daily basis.

Nevertheless, controversy surrounds the methylene blue test, primarily due to the fact that results vary widely between metalcasting facilities. Depending on your sand system, molding method and metals poured, a live clay count of 4%-8% might be appropriate. If the test is not administered properly, the results can vary within one metalcasting facility, meaning the operator can learn little from it. So, prior to the meeting that surprised Joyce in 2006, some in the industry had suggested that a new standard should be applied to the test to make the results consistent across all plants in the industry.

“The methylene blue test was developed in the late 60s, early 70s, and people have been talking about the variability since then,” said Jerry Thiel, director of the Univ. of Northern Iowa’s metalcasting center. “But the strength of the test is the sheer simplicity of the testing procedure. It can be done with limited equipment and personnel.”

The metalcasting industry is to this day still engaged in debates over whether the standards for the test should be changed in an attempt to benefit the entire industry. But as long as you follow proper procedures and avoid a few of the standard pitfalls, you can obtain quality results from the methylene blue test and benefit your entire facility.

Performing the Test

The existing standard for performing the methylene blue test will work for your metalcasting shop. Controversy aside, once you have established a consistent pattern of results in your plant, outside results won’t affect yours.
According to the American Foundry Society’s Mold and Core Test Handbook, you should first obtain and weigh in a beaker a 5 g sample of dried molding sand from your facility’s sand system. The sample should be representative of your sand system as a whole, meaning it should have roughly the same composition as any batch of sand you might use. Next, add 50 mL of 2% sodium pyrophosphate to the sand in the beaker. Once that solution has been prepared, you can do one of two things to prepare the sample to be mixed with the methylene blue solution—boil it for 10 minutes or place it in an ultrasonic unit for seven minutes.

The mixture is then ready to be treated. First, add 80-90% of your system’s estimated methylene blue requirement, where 100% is the amount of methylene blue that would bring you to the endpoint of the testing procedure. This number depends on the amount of live clay your system typically contains. A system with 7% live clay, for example, would require about 35 mL of methylene blue to reach the endpoint (5 mL for each percent live clay is a good general rule). The starting point for this 7% system would be about 28 mL. If you are unsure what your typical percent live clay might be the first time you perform the test, err on the low side with about 20 mL of methylene blue. Record the number of milliliters used.

Stir the mixture for two minutes with a mechanical or magnetic stirrer, keeping the material in suspension without splashing. Remove some of the sample with a pipette and place a drop on a sheet of Whatman #50 filter paper. If a blue-green halo emerges around the blue dot that appears, you have begun with too much methylene blue and must start over with a lesser amount.

If a halo does not emerge, you can proceed by adding 1 mL of methylene blue to the sand mixture, stirring for two minutes, and placing another drop on the filter paper. Repeat this step until you observe the blue-green halo, then record the number of milliliters of methylene blue that were added to the original solution.

The results of the test are then calculated by first finding a calibration factor and then plugging that number into an equation that determines the amount of live clay. The calibration factor is found by dividing the original amount of methylene blue placed in the mixture with the known percent clay in your sand mixture, which includes both live and dead clay. Finally, to find the percent live clay in your system, divide the number of milliliters of methylene blue that were added to the original solution into the calibration factor.

Why All the Fuss?

The controversy surrounding the methylene blue test should never enter the walls of your business. As long as you avoid errors in the three areas that have launched the discussions about the test’s variability, there will be no debating the quality of your results.

Clay. There is no standard for clay. The naturally occurring substance comes in a variety of forms, depending on where and when it is found on the face of the earth.

“It is very difficult to provide a standard for a mined material,” Thiel said. “It was told to me a long time ago by a clay company that ‘God made it, we just dig it up.’ Sometimes, the sample...
doesn’t happen to be pure clay. And being a sedimentary material, it is laid down in layers, so clays in the same deposit aren’t exactly the same throughout.”

For this reason, each and every metalcasting facility performing the methylene blue test must do an accurate calibration on their existing sample in order to obtain meaningful results. The industry cannot set the standard for you.

To avoid errors when testing your particular clay, be sure to select a sample that is representative of the rest of your sand system. According to a paper by Daryl Hoyt, president of Foundry Sand Technology, Marseilles, Ill., lumps of clay or large non-clay particles can throw off the results of your test by a significant number of percentage points. If your test yields radically different results than you are used to getting, run the test again.

Methylene Blue Solution. The methylene blue solution itself also can be difficult to standardize. The solution can be prepared in-house or purchased from a supplier, and both solutions can encounter problems.

Do-it-yourselfers must prepare their methylene blue consistently to ensure their results point to real trends in their sand system.

Purchased methylene blue can introduce unspecified solution strength into the test. Problems developing from this concern can be avoided with accurate calibration.

“It’s assumed through your calibration that, even if your methylene blue is on the weak side, it would have still given you valid results if you did the calibration procedure properly,” Thiel said.

Whether concocted in-house or purchased, methylene blue must be handled carefully to ensure it maintains constant solution strength.

“The solution is dependent on how long you’ve had it,” said Mark Zeigler, director, Unimin Corp., Rockford, Ill. “And if it’s kept in sunlight, it will deteriorate.”

Store your methylene blue solution in air-tight amber containers to avoid any deterioration by sunlight or evaporation of the water in solution.

Test Interpretation. Errors also can be introduced into the methylene blue test when the operator attempts to interpret the results.

“The halo you get at the endpoint can be subjective, depending on when the operator thinks the halo occurs,” Zeigler said. “You can get a two or three point difference.”

Remember that the endpoint has been reached as soon as the green-blue halo appears around the edge of the methylene blue dot on the filter paper. The operator does not have to wait for a large ring; too much solution has been added to the mixture at this point, and the results will be incorrect.

“The accuracy is in determining if the halo is there at all,” Thiel said.

Testing the Waters

A group of metalcasters and scientists similar to the 24 that got together that day back in 2006 are still at it today. Working as a committee, they’re in the conference room and the lab trying to perfect the test that has tested their nerves.

“That’s what our committee is talking about, and we have several projects in place to come up with a resolution,” Zeigler said. “We’re reviewing the total procedure, that’s on our docket right now. I’d be guessing what we’re going to come up with.”

For now, metalcasters will have to rely on the existing standard for accomplishing the test. And as long as it’s done correctly, it fits the industry’s needs.

“There’s a lot more variation in the test than there should be,” Joyce said. “This test is kind of art and science put together. But it’s a good indicator of active clay in the system, and it’s all we’ve got right now.”

The Other Five

The methylene blue test, while subjective and sometimes controversial, is only one of six tests that should be conducted on a regular basis to ensure the quality of your sand system and, ultimately, your castings. The others are:

1. Compactibility
2. Moisture Content
3. Green Compressive Strength
4. Permeability
5. Specimen Weight

For More Information