



CONSIDERATIONS FOR A SUCCESSFUL CALSAFE[®] LIME SLURRY TRIAL

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Switching to lime as the reagent in your water or wastewater treatment process can bring a range of benefits. If you are thinking of making a change to your reagent, it might be time to consider a trial of *CALSAFE* lime slurry.



OVERVIEW

Chemical bases (alkalis) are used in a range of industries for a variety of purposes. They are, for example, commonly used to neutralize acidic wastewater streams so that cleaner discharge back into the environment is possible. Raising the pH of a wastewater stream can also allow the removal of harmful or toxic elements, such as heavy metals from acid mine drainage. At higher pH, these dissolved elements precipitate out of solution and can be recovered. Meanwhile, bacteria and other microorganisms that are used in some wastewater treatment processes are more effective at neutral to slightly alkaline pH values.



When used for the treatment of drinking water, high-pH reagents can be used in conjunction with coagulants to remove organic materials and pollutants. They also help reduce acid corrosion of metals, such as lead from lead pipes, into the drinking water and soften hard water streams.

A number of reagents are used in water treatment. These are predominantly hydroxides, with lime (Ca(OH)_2) and caustic soda (NaOH) being the most common but not the only products. Magnesium hydroxide (Mg(OH)_2) can also be used, as can sodium carbonate

(Na_2CO_3) and sodium bicarbonate (NaHCO_3). A number of factors go into the decision over which reagent to use. When considering the options, it is important to first understand how a particular reagent will work in your process in order to ensure the required results.

As an expert in the manufacture and use of lime products, Carmeuse is well positioned to help when considering lime as your reagent. To support the selection of the right product for your process, we offer trials of our *CALSAFE* lime slurry at your operation, which allow you to understand the performance, impact and benefits of using lime, before committing to any permanent modification of your plant and process.



The remainder of this white paper will outline the considerations for implementing a successful *CALSAFE* lime slurry trial. It will first be useful to have an understanding of the two most common reagents: lime and caustic.

LIME AND CAUSTIC: A QUICK INTRODUCTION

Lime comes in three basic forms: quicklime, hydrated lime and ready-made lime slurries, such as *CALSAFE*. The former two are supplied as dry products, but all three are almost always added to the process as a slurry for the purposes of water treatment. Users of quicklime or hydrated lime therefore require on site equipment to turn those dry products into slurry.



For the purposes of trialing lime in your process, *CALSAFE* lime slurry is the most convenient option. If the decision is made to switch to lime permanently, our expert application specialists will be able to guide you through the process of determining which of the three lime products is right for long-term use in your operation.

For more on how to choose the right lime product for your process, see our article: [Quicklime, Hydrate or *CALSAFE* Lime Slurry?](#)

One of the major benefits of using lime in your process is that it is significantly safer than other options, such as caustic. Contact with lime slurry can cause irritation of the skin and serious eye damage. Safety glasses with eye shields should always be worn, along with appropriate protective clothing (e.g., long-sleeved shirts). In contrast, exposure to caustic is likely to cause severe chemical burns to exposed skin; enhanced safety precautions—including PPE, and engineering and design safeguards—are therefore required.

CALSAFE lime slurry is also considered non-hazardous for ground transportation and storage, is compliant with NSF/ANSI/CAN technical requirements and meets the AWWA B202 93 standard.

A further challenge with caustic is its higher freezing temperature than lime. At 50% solution, it will start to freeze at 60°F, while lime slurry freezes at the same temperature as water. To mitigate this, a heating mechanism may be required on a storage tank for caustic. A 50% solution may also be diluted to prevent freezing since caustic solutions with lower percent-solids have lower freezing points, but this increases the size of the storage tank required.

A final—but most significant—point to note when discussing lime and caustic is cost.

Caustic is more expensive than lime, averaging \$490 per dry ton in the US in 2020, and can experience price fluctuations of hundreds of dollars over the course of a year, making it more difficult for users to budget their reagent spending. This price volatility results from the fact that caustic is a byproduct of the production of chlorine gas, which is principally used for the manufacture of PVC construction materials (windows, pipes, etc.). In periods of low construction activity, chlorine gas production therefore drops and, with it, the production of caustic. Prices of caustic are consequently higher during these periods, e.g., over winter.

By comparison, the production of lime is a stand-alone and stable process throughout the year, with prices nearly half that of caustic. Carmeuse can therefore deliver a reliable supply of *CALSAFE* lime slurry or its dry lime products, at consistent pricing, whenever the need arises.

For more on the differences between lime products and caustic, see our article: [Switching to Calcium Products from Caustic Soda](#).

In addition to the direct costs of dry products, lime slurry has a potency advantage in comparison to other common reagents on a dry basis. From a theoretical standpoint, the following weights of other bulk products are approximately equal to 1 dry ton of *CALSAFE*.

- 1.08 dry ton of caustic.
- 1.43 dry ton of sodium carbonate.
- 2.27 dry ton of sodium bicarbonate.

For all of the above reasons, it may be beneficial to consider switching to lime as your reagent. So, what do you need to do in order to successfully plan and run a trial, and how will it help determine whether making the switch presents value for money?



PLANNING A SUCCESSFUL *CALSAFE* LIME SLURRY TRIAL

The planning stage is the most important part of implementing a successful trial. Work done at this point is never wasted—and will often mean less work down the road. Our experts will collaborate with you to understand your existing process and objectives for the trial. We will make sure a comprehensive plan, with contingencies, is in place, communicated and understood by all relevant stakeholders, before a drop of slurry is delivered to your site.

Setting objectives

At the foundation of planning a successful *CALSAFE* lime slurry trial is understanding the trial objectives: these are the most fundamental questions we will ask and come in two parts. The first is to understand why you use a reagent in your process and what the requirements of that reagent are. Do you have acidic wastewater that needs neutralizing or metals that need removing? Essentially, what value do you need the lime to deliver for your process?

This matters because it will impact the amount of lime needed. If the aim is to neutralize acidic water (i.e., achieve a pH of 7), this will require less lime than if the aim is removing metals, which typically requires a higher pH. Each metal, however, has a different ideal pH for their removal. If you have a cocktail of metals, a pH of 10 may be generally appropriate—but this can only be determined when we understand your needs.

The second part to setting objectives relates to why you are trialing lime in particular. For example, if you are currently using caustic in the process, what has made you decide to consider the switch? An understanding of your current process is helpful here since this will help us determine what particular benefits switching to lime may bring and any challenges that may result. We can then tailor the trial accordingly.

Process parameters

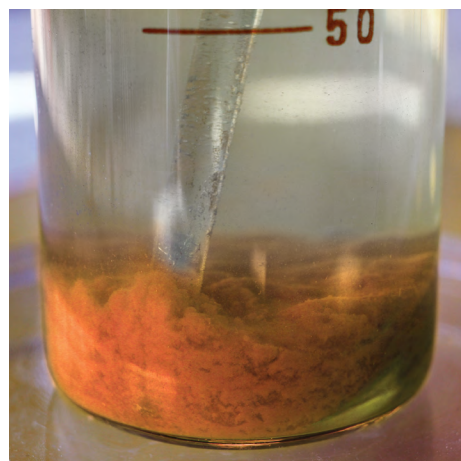
On a practical basis, we need to understand your existing reagent usage (type and amount) and, ideally, receive a sample of both the reagent and the wastewater to test at our Innovation Center in Pittsburgh. This allows us to determine how much slurry you may need to achieve your process goals, which will help determine the size and scope of the trial. Our experts are able to help with the sampling process, providing guidelines on the size of sample to take, how to take it and how best to ship it.

From this initial testing, we can define anticipated usage rates and provide a cost estimate for the trial, as well as undertaking initial cost-benefit analysis to compare lime with your existing reagent. It will also help us understand the chemistry of your water stream and so recognize whether there may be any byproducts produced during the trial that will need to be managed. For example, sulfates stay dissolved in water when using caustic but precipitate out when using lime slurry. Metals precipitate using either reagent, but more efficiently when using lime.

Other parameters that are important to understand include:

- What equipment is already in place at your site?
- How do you store, dose, and mix your reagent at the moment?
- Are there any clarification/filtration steps in the process?
- What automation or control systems are in place?

On the last point, it will be important for us to understand what the process control limits are and what sort of control signals are already in place that we can use during the trial. Typically—and especially if you are using caustic in the



existing process—there will be some sort of control loop to automatically adjust the flow of caustic into the process. This system can be utilized during the trial (as long as the pH sensor is located downstream of the point where we will inject the CALSAFE lime slurry).

At this stage, it is also important to understand how much your process fluctuates. For example, at drinking water treatment plants the process is pretty constant in terms of quality and quantity. In contrast, at wastewater treatment facilities, flow rates may change dramatically over time, as does the quality of the water. An understanding of these variables allows us to plan how best to manage them: a simple feedback loop might be acceptable in processes with little fluctuation. When the process varies dramatically, however, the process might have to be manually operated.

Trial duration

When we understand your objectives and process, we will be in a position to work with you to determine the appropriate duration of the trial.

Much will depend on the complexity of the process downstream of the point where lime is added. If the addition of the lime is one of the last process steps, a shorter trial may be achievable, because there are fewer downstream impacts to consider. However, if lime is added earlier in the process, a longer trial may be required in order to adequately assess the effects of switching to lime through the complete process.

Our process application specialists will work with you throughout this process and provide their recommendations, based on their in-depth industry expertise.

Cost of the trial

Cost will depend on the range of factors outlined above—from the treatment requirements and how much lime will be required to achieve these, to the trial duration. When we understand these factors, we will be able to provide a tailored quote for the cost of the trial.

Sample taking and testing

During planning, we will work with you to identify any concerns that may arise over sampling and testing, and plan a sample-taking process and schedule that makes sense given the process parameters. This will include discussion of the following:

- What equipment is required? Is it already available on site or will we need to supply it?
- To whom will we report the results of the testing? Who are the process owners that will make decisions based on those results?
- Will we send trials to the Carmeuse Innovation Center for more comprehensive testing or will onsite testing be sufficient?

When all is agreed, this will be clearly communicated ahead of the trial with the onsite operators along with any required support or training.

Site surveys

As a final element of pre-trial planning, one of our trial team will visit your site, usually a couple of months in advance of beginning the trial, to walk down the area where we will inject the slurry and review the rest of the downstream process. During this site survey, we will confirm everything discussed to this point, e.g., the location of pH testing/control sensors and whether this is appropriate for the trial (or, if it is not, whether they can be moved or whether we will need to supply alternative testing/control equipment).



Also during the site survey, we will check the location where the *CALSAFE* lime slurry will be stored to make sure there is enough space, and the correct utilities and services are available. This includes electricity supply, water and compressed air, as well as chemical containment equipment to deal with any minor leak. The absence of any these does not prevent the trial taking place; however, it does need to be known and planned for ahead of time since, for example, if plant air is not available, we will need to provide a compressor.

Safety will also be discussed at this point to make sure we meet all local and plant safety guidance and regulations in terms of training and PPE. It is helpful to know, for example, if our trial team will be required to undertake onsite safety training before working on site.

We will also raise any concerns we may have or identify during our site survey. For example, whether any other hazardous chemicals will be stored in the same area as the *CALSAFE* lime slurry, and what the procedures are in the event of a spillage or accident. Although lime is not flammable or explosive, it can react violently with highly-acidic waste streams, generating significant heat, which can be sufficient to ignite other flammable materials in the immediate area.

For more on how to handle and store *CALSAFE*, see our article: [Lime Slurry Handling: A Good Practice Guide](#).

RUNNING A SUCCESSFUL *CALSAFE* LIME SLURRY TRIAL

Delivery and storage of lime

There are two options for managing the delivery and storage of lime to your site. For smaller and/or shorter trials, we deliver 300-gallon totes of *CALSAFE*, in the quantity required. The totes double as shipment and storage containers, and are delivered with a pump—for a convenient all-in-one option. For larger trials, we offer a mobile 13,500-gallon mix tank, which we deliver to your site, along with the necessary ancillary equipment (e.g., pumps). For tote-based trials, we will need a supply of plant air, while for the larger mix tank, hook-up to an electricity supply is required.

Manpower and supervision

We will manage the delivery of equipment and slurry to your site, as well as integrating it into your process. There will also be a Carmeuse operator available locally for the duration of the trial. This operator will generally attend the system once or twice a day to check the systems are running and undertake any maintenance, as well as being on-call in an emergency. If any plant maintenance is planned, this should be communicated ahead of time, so our operator can be present when this is taking place.

During times when our operator is not on site, we will provide training for a plant employee(s) to supervise, undertake basic operation, and stabilize the system, when required, and information on who to contact in an emergency. The system will need to be checked on a predetermined schedule (hourly, half hourly, etc.), which will be clearly communicated to the relevant plant employee(s). As a rule of thumb, the tote-based system will require more supervision than the mix tank, which is a much more heavily-engineered system. More supervision will be required when the process is highly variable.

As mentioned above, we will also—at least initially—work with the onsite operator(s) to take samples, as appropriate, and undertake on site testing to understand if there is any cause for concern. This is particularly relevant when we expect the use of *CALSAFE* lime slurry to generate solids. In these circumstances, before and after samples are taken to see what and how much solids are generated.



Process switch-over

The process of switching to lime may be managed in a couple of ways. It is possible to simply stop the existing reagent and start-up the lime. A gradual approach may be better, however, whereby the existing reagent is slowed, as the lime is ramped up (with the reverse taking place at the end of the trial). This will be discussed and agreed during planning.

There are three times a switch between products may occur: at the start and end of the trial—and if the trial is paused for any reason. The trial may be paused for a number of reasons, and the conditions that would result in a pause must be clearly defined and communicated ahead of the trial, as well as the process for pausing the trial safely.

Contingency plans

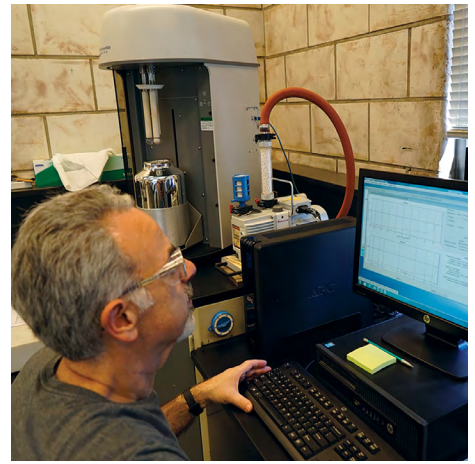
There are two major contingencies to consider: equipment and manpower. When it comes to equipment, we will generally have duplicates of the crucial equipment available on site, or have a plan for where we can source such equipment quickly. If any major change to the process is required, and extra manpower needed to manage this, we will have agreed ahead of time whether this will be provided from among your workforce or by us.

ANALYZING AND INTERPRETING THE RESULTS

After completion of the trial, you will have access to and support from our leading lime and limestone experts. Based out of the Carmeuse Innovation Center in Pittsburgh, our chemical and physical laboratory capabilities are able to perform sophisticated test procedures and evaluations to assess the use of lime products in your application.

The resulting factors will inform any decision over whether to switch permanently to lime as your reagent, and what the implications of this may be in terms of your process and equipment:

- **Solids:** The treatment of water with lime may result in the precipitation of solids, as both a desired effect (in the case of heavy metals removal from a wastewater stream) and as a byproduct. The properties and amounts of solids generated will be analyzed for their impact on the process and equipment: for example, whether any process changes or new equipment, such as filtration and clarification systems, are recommended to allow the use of lime on a long-term basis. The generation of solids may also generate a new waste stream, the management and costs for disposal of which will also need to be understood.
- **pH behavior:** How does the *CALSAFE* lime slurry effect the pH through the whole process? Generally, lime slurry reacts more slowly than caustic. Therefore, it is important to understand accurately how much lime is required to achieve the target pH, which means understanding at which point the lime has fully reacted into the water or wastewater stream. You do not want the lime to continue to react beyond the end of the process, for example, following release to waterways, which are bound by environmental quality parameters, with regulatory response for outfall that does not meet these standards.
- **Dosing rate:** This is related to the above and is relatively straightforward: at the end of the trial, we will be able to say how much *CALSAFE* lime slurry has been consumed to meet the required goals. Typically, this will be provided as a consumption rate against a particular variable, for example, flow, from which annual consumption rates can be estimated for given conditions. This is an important factor, firstly for helping to decide what type of lime product is best suited to the process (whether slurry, quicklime or hydrate). When consumption rate is multiplied by the cost of the product (per ton or gallon), it is also possible to estimate a total reagent cost.



- **Equipment:** This is also related to dosing rate and consumption. The biggest variable when handling lime slurry is the size of the mix tank. There are other considerations, however, if quicklime or hydrate are selected as the most appropriate lime product for your process. Carmeuse Systems has over 50 years of experience designing, upgrading, and maintaining lime handling equipment, and can help evaluate your operations. The need for any new equipment to manage waste products should also be considered here.
- **Pipe scaling:** Scaling is not usually an issue when it comes to the trial, unless it is a long-running trial. Long-term scaling issues can be modeled mathematically, for example, with the Langelier Index.

AFTER THE TRIAL: HOW CAN CARMEUSE HELP?

As a leading expert in lime and its uses, Carmeuse is ideally positioned to advise you on the use of *CALSAFE* lime slurry and other lime products in your process. Our experts are driven by a desire to help you fully realize the performance, cost-effective and environmental benefits of our lime products. For questions about equipment, handling and storage, the team at Carmeuse Systems, is here to support you in making the best choice for your operation. Each of our system designs includes full engineering documentation, secure equipment shipment, start-up support, and commissioning. We also offer aftermarket support and maintenance for both Carmeuse Systems and third-party equipment to keep your process running safely, reliably, and efficiently.

If high reagent prices and price volatility are making your operations difficult, it might be time to consider a *CALSAFE* lime slurry trial to understand the benefits of lime for pH adjustment, metals removals or disinfectant. Interested in finding out more? Let's talk. Visit www.carmeuse.com or call 866-780-0974. ■



Carmeuse is your trusted partner from source to solution with our End-2-End Services offering providing raw materials, freight & logistics support, and lime handling systems. Every step of the way, we go above and beyond to make things simple for our customers and we have the expertise to help in whatever you may need from choosing the correct raw material to maintaining your lime system.

PLEASE CONTACT US VIA EMAIL OR PHONE AND WE CAN RECOMMEND A PRODUCT TO BEST MEET YOUR NEEDS.

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