

BAKING UPDATE

Chemical
Leaveners

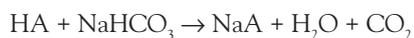
Practical technology from Lallemand Inc., parent of American Yeast Sales, producers and distributors of Eagle® yeast, fresh and instant.



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Neutralizing Values

When a leavening acid (shown here as HA) reacts with a carbon dioxide source like baking soda, it produces water and carbon dioxide gas according to this general neutralization reaction:



All leavening acids react with carbon dioxide sources to produce gas. The potential gas production depends on the amount of the carbon dioxide source. The actual gas production depends on the ratio of total leavening acids to carbon dioxide source. The neutralizing value (NV) is the parts by weight of baking soda from which all available carbon dioxide will be released by 100 parts by weight of a leavening acid:

$\text{NV} = \text{g NaHCO}_3$ neutralized by 100 g acid

Leavening balance is achieved by using the neutralizing value to match the amount of leavening acid to the amount of baking soda so that the maximum amount of car-

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A Guide to Chemical Leaveners

CHEMICAL LEAVENERS are used to give cookies, cakes, and other baked goods their characteristic textures. They produce gas from the reaction that takes place when a carbon dioxide source and an acid are mixed together and come into contact with water. The gas forms bubbles that are trapped in the batter or dough and then expand during baking to form the holes that are retained in the finished product.

CHARACTERISTICS

Baking soda is the most common carbon dioxide source. It is low in cost, high in purity, easy to handle, and leaves no after-taste. Flour and other ingredients are slightly acidic, so baking soda will release some carbon dioxide if added by itself but will produce more when more acid is added.

Baking powder contains baking soda, one or more leavening acids, and a filler. The leavening acids are added in their powdered form as salts which do not react until they dissolve in water. The filler (starch

or calcium carbonate) stabilizes the product by keeping the baking soda and leavening acid separate and standardizes it to the desired strength.

Leavening acids are selected primarily on the basis of reactivity—how fast they react and at what temperatures. Reactivity depends mostly on solubility, which in turn depends on chemical composition, particle size, and special treatments such as coating.

Single-acting baking powders contain a single leavening acid and can be slow acting or fast acting. Slow-acting types are the most common and use a slow-acting acid like SALP that reacts very little until heated in the oven. Fast-acting types are less common but use a fast-acting acid such as cream of tartar to provide gas production at low temperatures immediately after addition.

Double-acting baking powders contain a mixture of a fast-acting leavening acid like MCP and a slow-acting leavening acid like SAPP. They react partially at low temperatures and partially at high temperatures

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CHEMICAL LEAVENING INGREDIENTS

INGREDIENT NAME	COMMON NAME	FUNCTION	CONSIDERATIONS
Sodium bicarbonate	Baking soda	CO ₂ source	Most common CO ₂ source, required in baking powder
Potassium bicarbonate		CO ₂ source	Used in place of baking soda in low-sodium applications
Ammonium bicarbonate		CO ₂ source	Ammonia taste limits use to low-moisture products
Tartaric acid		Leavening acid	Very rapid action
Monopotassium tartrate	Cream of tartar	Leavening acid	Rapid action
Monocalcium phosphate monohydrate	MCP	Leavening acid	Rapid action, used in double-acting baking powder
Anhydrous monocalcium phosphate	AMCP	Leavening acid	Coated for slower action than MCP
Sodium acid pyrophosphate	SAPP	Leavening acid	Slow to very slow action, slightly bitter aftertaste
Sodium aluminum phosphate	SALP	Leavening acid	Slow action, used in single-acting baking powder
Sodium aluminum sulfate	SAS	Leavening acid	Very slow action
Dicalcium phosphate dihydrate	DCPD	Leavening acid	Very slow action
Glucono-delta-lactone	GDL	Leavening acid	Slow action, slightly bitter aftertaste
Calcium sulfate		Filler	Inert
Calcium carbonate		Filler	Inert
Corn starch		Filler	Inert

Lallemand Products for the Baker

LALLEMAND Inc. is a leading producer of yeast and dough conditioners and supplies a full range of products to the baking industry through its subsidiaries Lallemand Distribution and American Yeast Sales.

Chemical Leaveners

- Single-acting and double-acting baking powder
- Bakers cream

Yeast Foods and Oxidizers

- Single-strength and double-strength yeast food
- Bromate-free yeast food
- Bromate, L-cysteine, ADA, ascorbic acid

Preservatives

- Powdered, granular, and dust-free calcium propionate
- Sodium propionate
- Natural mold inhibitors
- Potassium sorbate and sorbic acid
- Vinegar and raisin juice

Emulsifiers

- Sodium stearoyl-2-lactylate (SSL)
- Calcium stearoyl-2-lactylate (CSL)
- Monoglycerides
- Mono- and diglycerides
- Ethoxylated mono- and diglycerides

Sugars and Syrups

- Granular and brown sugar
- Liquid and dry malt syrup
- Liquid and dry honey and molasses
- Corn syrup, bakers syrup, and ceralose

Shortening

- Butters, margarines, and shortenings
- Soy, cotton seed, canola, and olive oils

Dairy and Egg Products

- Whole, nonfat, dry, and buttermilk
- Whey and dairy blends
- Liquid, frozen, and dry eggs, yolks and whites 

A Guide to Chemical Leaveners (Continued)

to provide uniform leavening throughout processing.

Potassium bicarbonate and **ammonium bicarbonate** are carbon dioxide sources that are sometimes used in place of baking soda. Potassium bicarbonate can be used for low-sodium applications. Ammonium bicarbonate can be used for low-moisture finished products (such as cookies) where its ammonia taste dissipates after baking.

Taste is influenced by the choice of leavening acid and ratio of leavening acid to baking soda. SAPP and GDL have a slightly bitter aftertaste in some applications, but the SAPP taste can be masked by using sufficient baking soda and by adding a source of calcium ions, sugar, or flavorings.

Texture is also influenced by the choice of leavening acid. Calcium and aluminum-containing leavening acids allow good gluten development for volume and texture, while sulfates and phosphates interfere with gluten development and reduce gas retention. GDL also allows good gluten development and gives acceptable crumb texture in breadlike products which normally are leavened with yeast.

Crumb color is influenced by the pH of the finished product. A low pH from low baking soda levels gives whiter crumb color. A high pH from high baking soda levels gives a darker crumb color that is desirable in chocolate products.

APPLICATIONS

Cake donuts require little leavening during mixing, then some for buoyancy at the start of frying, and considerable fast leavening during frying. SAPP is commonly used as the leavening acid, sometimes with added MCP for initial activity or GDL for late activity.

Layer cakes require leavening during mixing to give good batter consistency for pan fill, and additional leavening during baking for optimum crumb texture and volume. Double-acting baking powder is commonly used with MCP as the fast-leavening acid and SAPP or SALP as the slow-leavening acid.

Refrigerated doughs for biscuits require a leavening system which produces some gas in the can after mixing, but which also retains the major part of the activity until the biscuit can is opened and the biscuits are baked. MCP is used to have some gas produced in the can, while SALP or DCPD are used to produce gas in the oven after a long period of refrigerated storage.

Biscuits and muffins require fast leavening in the oven because of their short bake times. Double-acting baking powder is commonly used with MCP or coated MCP as the fast-leavening acid and SALP as the slow-leavening acid. 

Neutralizing Values

(Continued)

bon dioxide is produced. If too little leavening acid is added, less gas is produced and the residual baking soda raises the pH of the finished product. If too much leavening acid is added, gas production remains the same but SAPP and GDL will leave a bitter aftertaste in the finished product.

For example, pure SAPP has an NV of 72 but is also available in standardized form with an NV of 50. For a cake donut application that uses baking soda at 2 percent of flour weight, standardized SAPP with an NV of 50 should be added at 4 percent of flour weight to provide leavening balance:

$$4\% \text{ SAPP} = \frac{2\% \text{ NaHCO}_3}{50} \times 100$$

NEUTRALIZING VALUES

Tartaric acid	116
Cream of tartar	45
MCP	80
AMCP	83
SAPP	72
SALP	100
DCPD	33
SAS	100
GDL	45

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BAKING UPDATE

Lallemand Baking Update is produced by Lallemand Inc. to provide bakers with a source of practical technology for solving problems. If you would like to be on our mailing list to receive future copies, or if you have questions or comments, please contact us at:

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