
Technical

Specifications

United States Gypsum Company
Industrial Gypsum Division
125 South Franklin Street
Chicago, IL 60606-4678
Technical Assistance:
(800) 487-4431

Calcium Sulfate For The Baking Industry

Nutritional Considerations

Surveys of food consumption have shown that calcium is one of the nutrients frequently lacking in American diets. Good to excellent food sources of this element are limited. Milk is one of the best sources but its increased cost has caused a decrease in consumption. Enriched bread has been the second best source because of certain ingredients which are unique to the baking industry in the U.S. Nonfat dry milk and other milk derivatives, yeast foods, certain dough conditioners, and mold inhibitors—all calcium based—have been common ingredients of bread.

The U.S. Recommended Daily Allowance for calcium is 1,000 mg. (1/28 oz.), a level difficult to achieve with present-day foods. Analysis of numerous market samples of enriched bread has indicated an average calcium content slightly higher than 400 mg. per lb. (range 175 to 900 mg.). For this reason, nutritionists have hoped that calcium enrichment of bread and flour would be mandatory when the long delayed changes in the standards for these two foods were made. However, the Food and Drug Administration continues to declare calcium an optional nutrient and has set the level of calcium at 600 mg. per lb. of enriched bread and 960 mg. per lb. of enriched flour. Because enrichment of bread and flour is voluntary, it offers bakers and millers an excellent opportunity to demonstrate their interest in nutrition and the welfare of their customers by raising the calcium content of their products to the permitted level.

An excess of phosphorus in the diet interferes with the assimilation of calcium. A calcium phosphorus ratio of 1:1 is satisfactory, but for babies and young children a ratio of 2:1 is even more desirable. Many foods are high in phosphorus but few are good sources of calcium. For instance, meat has a calcium/phosphorus ratio as low as 1:20 and bread without calcium enrichment has a calcium/phosphorus ratio as low as 1:3. Calcium at a level of 600 mg. per

lb. of bread would raise this ratio to 1.2:1—thus would help offset some of the lack of calcium in the average diet and make bread more generally recognized as a nutritious food.

Functional Value of Calcium in Baking

Fortunately, calcium also has a functional role in bread production. A deficiency of this element causes bread dough to be soft and sticky, and to produce bread of poor quality. Bakers have recognized this functional role through their use of yeast foods which always contain a calcium salt. The Arkady-type yeast contains calcium sulfate; the Fermaloid type, calcium acid phosphate.

For enrichment purposes, calcium sulfate is superior to any of the phosphate salts of calcium because it can be used at much higher levels than are required to enrich bread without adversely affecting bread quality. Phosphate salts, on the other hand, add still more phosphorus to the product, making it difficult to obtain an ideal calcium phosphorus ratio. Mono-calcium and dicalcium phosphates at levels required for enrichment adversely affect the pH of doughs. Tricalcium phosphate, unless very finely ground, produces a chalky taste. Calcium carbonate, used in England, neutralizes the acids produced by fermentation and therefore increases fermentation time for highest quality bread.



Calcium Enrichment Requirements

To find how much calcium enrichment material must be added to a bread dough, it is necessary to determine the amount of calcium being contributed by other ingredients. The normal ingredients of enriched bread that provide significant sources of calcium are yeast foods, calcium propionate, nonfat dry milk, dried whey, monocalcium/phosphate and white flour. The calcium content of these ingredi-

ents—increments of general usage (in percent of flour weight) and total calcium contributed by each increment are given in Table I. Also listed is information on USG® Terra Alba and SNOW WHITE® Filler as enrichment sources. The table may be used to determine the calcium content of your bread so you may know how much enrichment calcium to add.

TABLE I
Calcium Enrichment Contributions

Ingredient	% calcium content	increments of use % flour weight	Mg. calcium contributed per lb./bread
USG Terra Alba—F&P Grade (CaSO ₄ · 2H ₂ O)	23.0	0.1	63
SNOW WHITE Filler—F&P Grade (CaSO ₄)	29.0	0.1	79
Arkady-type yeast food—single strength	7.4	0.1	20
Arkady-type yeast food—double strength	14.8	0.1	40
Fermaloid-type yeast food	8.5	0.1	23
Calcium propionate	21.5	0.1	59
Nonfat dry milk	1.31	1.0	36
Dried whey ⁽¹⁾	0.64	1.0	17
Monocalcium phosphate	17.1	0.1	46
White flour	0.011	100.0	30

(1) For proprietary mixtures containing whey, calcium content must be obtained from manufacturer.

The following is an example of the use of values given in Table I to determine the amount of USG Terra Alba—F&P Grade or SNOW WHITE Filler—F&P Grade needed for a given formula.

Ingredient	% of formula	Mg. calcium contributed per lb./bread
White flour	100.0	30
Water ⁽²⁾	variable	—
Sugar	7.0	—
Shortening	3.0	—
Salt	2.0	—
Yeast	2.0	—
Emulsifier	0.6	—
Arkady-type yeast food	0.25	50
Calcium propionate	0.20	118
		198

(2) Hard water will add some calcium, but since the amount in most water supplies varies from month to month, its contribution would be difficult to calculate and could constitute only a reasonable excess compatible with good manufacturing practice.

Because the previous formula produces bread having only 198 mg. calcium per lb., a baker desiring to meet the optional calcium enrichment level must provide an additional 402 mg. calcium (600-198) per lb. Since each 0.1% of USG Terra Alba (based on flour weight) will supply 63 mg./lb., 402 divided by 63/0.1 or $\frac{402 \times 0.1}{63}$ yields the percentage of USG Terra Alba

that must be added to the formula. This amounts to .64% or 10.2 oz. per cwt. of flour. Because SNOW WHITE Filler has a higher calcium content than USG Terra Alba, smaller amounts will be required as determined by dividing 402 by 79/0.1 or $\frac{402 \times 0.1}{79} = 0.51\%$

or 8.1 oz. per cwt. of flour. By using 10.5 to 11 oz. of USG Terra Alba or 8.5 oz. of SNOW WHITE Filler, an adequate safety factor is provided.

TABLE II
Typical Analyses

	USG Terra Alba— F&P Grade (HYDROUS)	SNOW WHITE Filler— F&P Grade (ANHYDROUS)
Total calcium	23.0%	29.0%
CaO	32.31%	40.92%
SO ₃	45.22%	57.46%
CaSO ₄	0.39%	97.68%
CaSO ₄ · 2H ₂ O	97.1%	—
SiO ₂ and insolubles	0.24%	0.13%
Fe ₂ O ₃ · Al ₂ O ₃	0.12%	0.12%
CaCO ₃ · MgCO ₃	1.52%	0.77%
Water loss at 250°C	20.31%	0.33%
Whiteness index—minimum ⁽³⁾	84.4	97.1
Solubility (70°F) per 100 c.c. of H ₂ O	0.26 grams	0.26 grams
Bulk density—pcf		
Loose	42.0	44.0
Compacted	70.0	80.0
Screen analyses		
Through 100 mesh—minimum	100.0%	100.0%
Through 325 mesh—minimum	93.0%	97.0%
Avg. particle size—microns	17	8

(3) The whiteness index is determined on a Beckman DU Spectrophotometer using magnesium oxide as the standard.

Use of USG Terra Alba and SNOW WHITE Filler Dietary Calcium

USG Terra Alba and SNOW WHITE Filler F&P Grade, supplied by United States Gypsum, are ideal sources of high-grade calcium sulfate for enriching bread. SNOW WHITE Filler also has been used successfully to extend TiO₂, which offers no nutritional value, in icings. Larger quantities of SNOW WHITE Filler than of TiO₂ are required, but it provides an attractive whiteness, supplies elemental mineral calcium and is low in cost.

Continuous quality-control tests performed in a modern, well-equipped laboratory ensure uniformity and purity. Both USG Terra Alba and SNOW WHITE Filler meet Food Chemicals Codex Specifications.

USG Terra Alba—F&P Grade and SNOW WHITE Filler—F&P Grade are manufactured only at Southard, Okla. Shipments are made in bulk or bagged carloads and bagged truckloads. LTL quantities are available in many areas through U.S. Gypsum Industrial Gypsum Division distributors. For further details, contact United States Gypsum Company, Industrial Gypsum Division, P.O. Box 803871, Chicago, IL 60680-3871.

For further information please call (800) 487-4431.
For orders please call: (800) 621-9523.