



**ALL THINGS
BAKING**

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& Convention Center**
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Freezing Technology



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Freezing Technology

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Advantages

Stabilizes Production Schedules

- Reduces changeovers.
- Reduces overtime and non-productive time.
- Helps meet peak demand at lowest direct labor cost.
- Improves material inventory control.
- Helps retain good employees.

Advantages

Extends Shelf Life

- Increases potential distribution area.
- Increases potential for variety.
- Reduces stales.
- Reduces equipment and space requirements at in-store bakeries.
- Decreases frequency of delivery to retail (reduces distribution cost per unit).

Disadvantages

- Is it fresh?
- Freezing correctly still decreases shelf life by 1 day.
- It requires more space and equipment.
- It requires good control of freezing and thawing.

Disadvantages

- Formulation cost is increased
- Packaging cost is increased
- Some control over finished product quality is lost
- It requires more maintenance

Yeast Activity in Retarded Doughs

Retarding Temperature: 40°F (4°C)

- Yeast activity is slowed
- 24- 48 hours maximum retarding time.

Yeast Activity in Frozen Doughs

Freezing Temperature: - 20°F (-29°C)

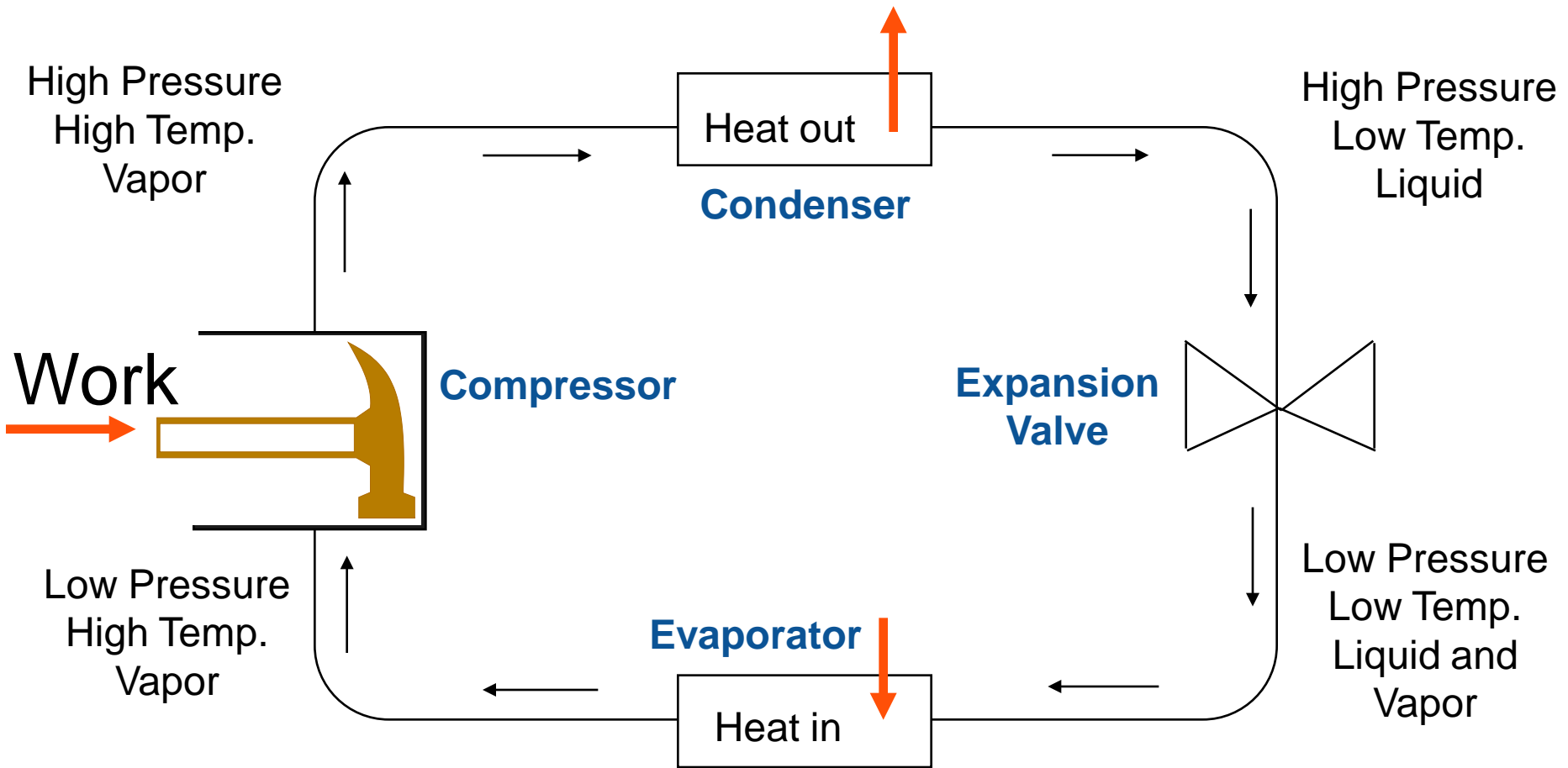
- Moisture turns into ice crystals.
- Yeast activity is stopped.
- Yeast activity will resume if freezing and thawing are done correctly.
- Shelf life of several months.(12 to 16 weeks is maximum)
- Sweet Goods, Cookie & Donuts (~ 6 months maximum)

General Guidelines for Batters

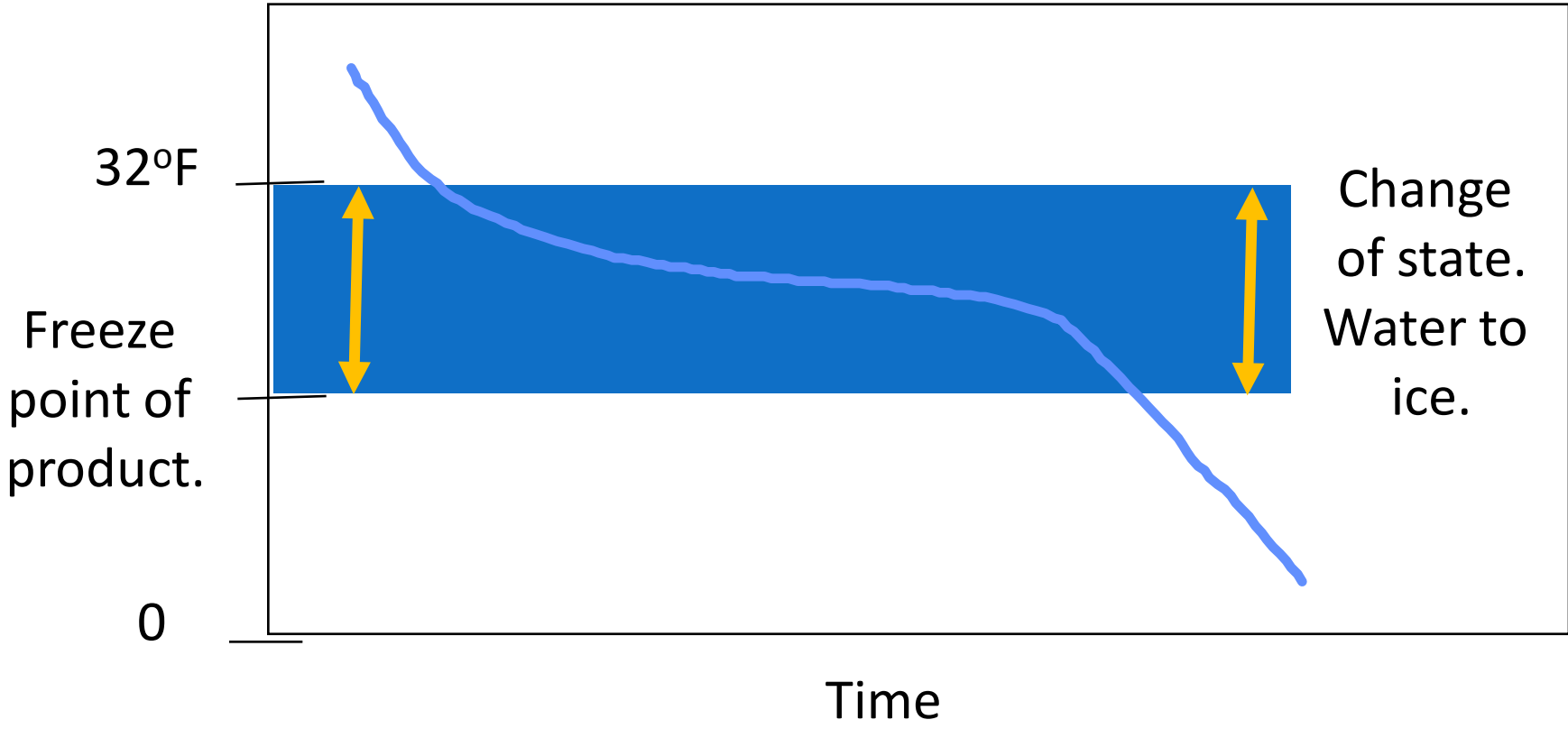
- Increase total leavening 20% – 25%
- Use proper sodium bicarbonate
- Delay addition of leavening
- Minimize floor / bench time
- Lower batter temperatures are desired
- Use heat activated and/or slower acting leavenings to provide adequate leavening activity for the oven

More Guidelines for Batters

- Use tolerant formulations
- Use high sugar, high fat formulations
- Use proper emulsifiers
- Use proper hydrocolloid systems
- Consider water amount in formulas
- Utilize the best freezing technologies
- Prevent freeze/thaw cycling



Transfer heat from where it is NOT wanted to where it can be tolerated



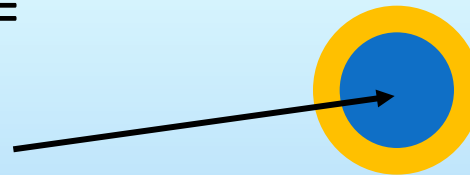
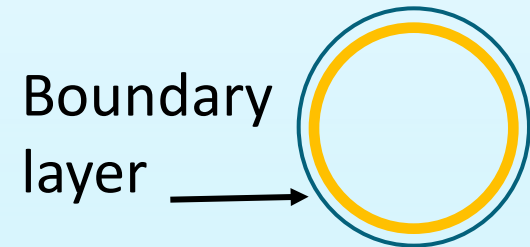
Freezing Methods

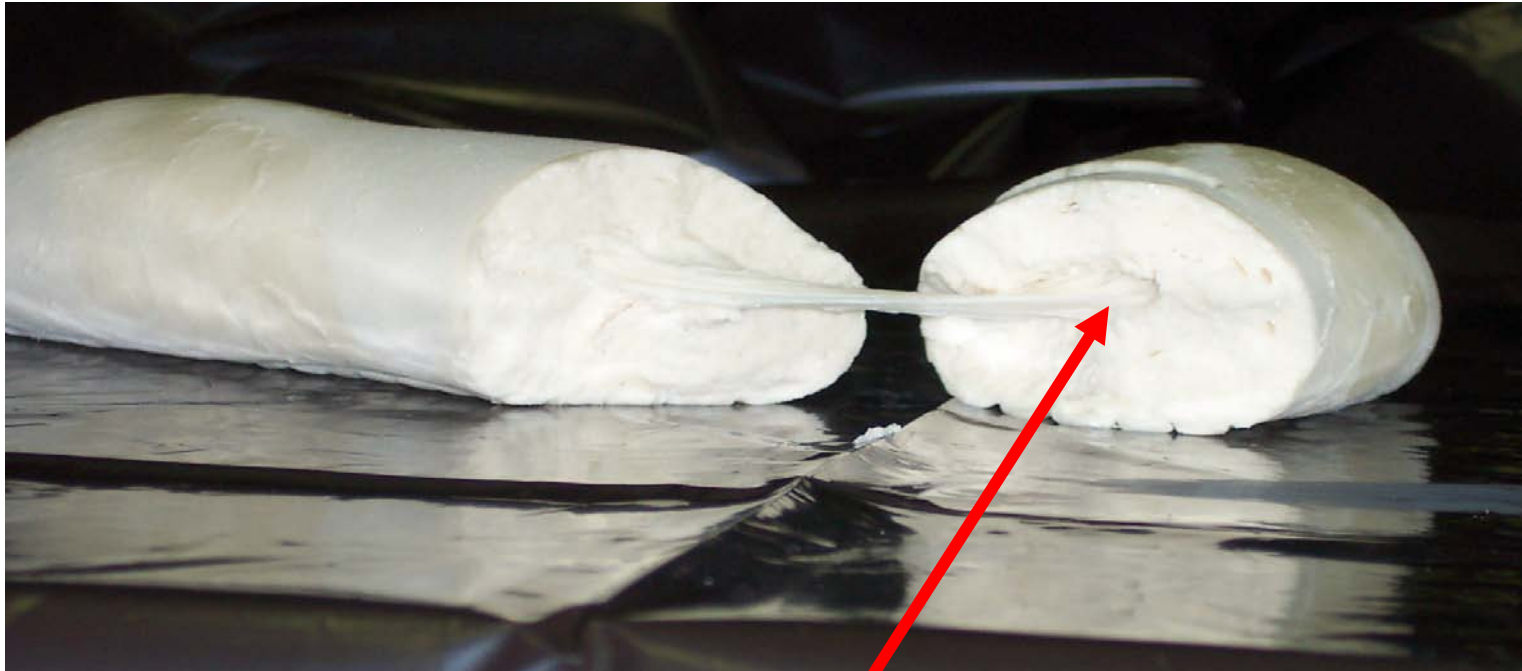
- Air blast - mechanical
- Cryogenic
 - Liquid CO₂ : - 110°F (-79°C)
 - Liquid N₂ : - 320°F (-195°C)
- Contact plate

Freezing of Dough

Mechanical Blast Freezers

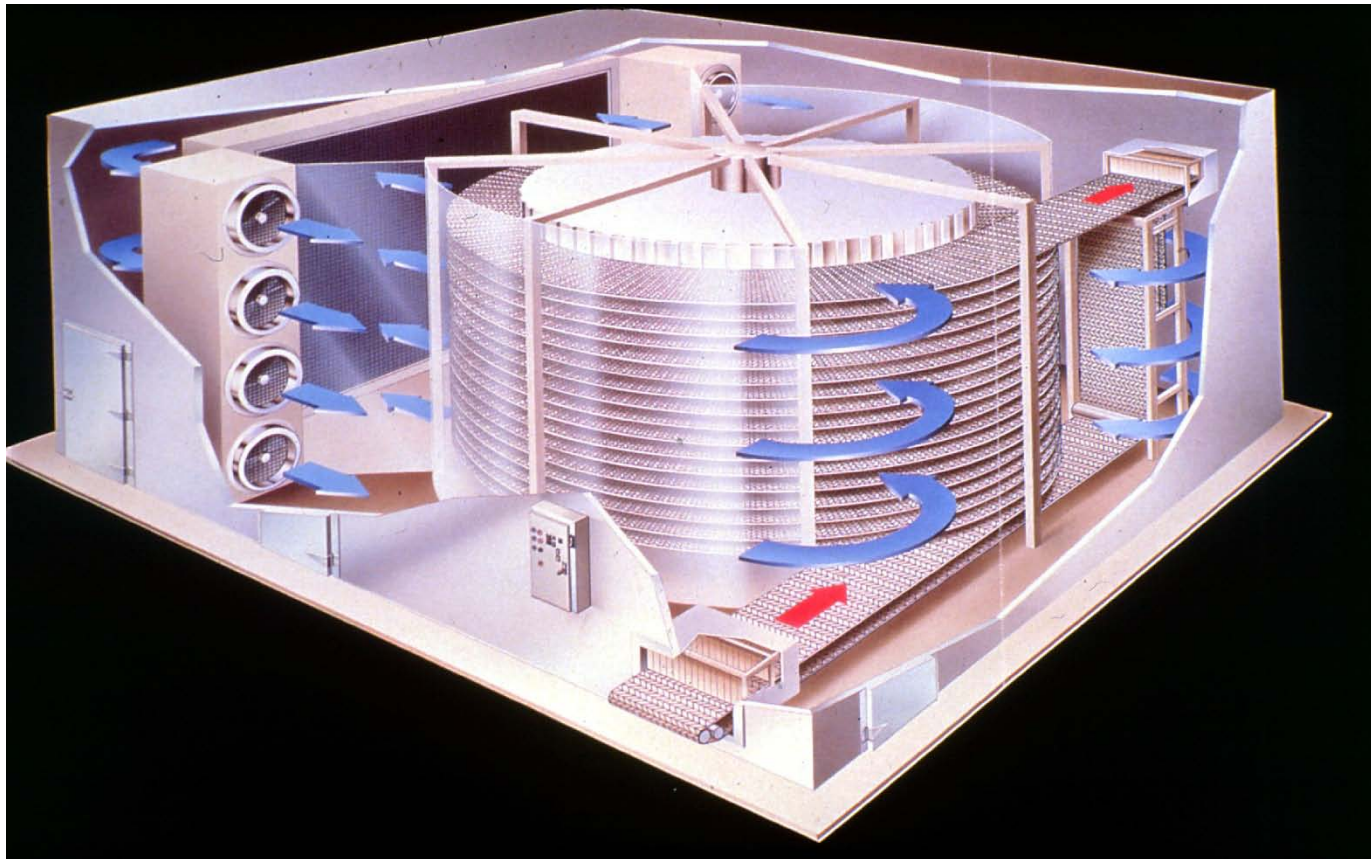
- - 30 to - 40°F (- 34 to - 40°C).
- 200 to 700 ft./min.
(= 600 ft./min. is best).
- Core temperature =
23°F (- 5°C).
- Freeze time - 18 oz. dough unit for
40 to 70 minutes.





23°F (-5°C) Internal Temperature
after 55 minutes

Mechanical Blast Freezer



Cryogenic Freezing

Tunnel Freezers Using:

- Liquid CO₂ - 110°F (- 79°C)
- Liquid Nitrogen - 320°F (- 196°C) or combined with Mechanical Blast Freezers.

Only a Shell Freeze with temperature equilibration in the holding freezer.

NOTE: Yeast is killed at - 40°F (-40°C).

Cryogenic Freezer



CARDOX ULTRA-FREEZE® CRYOGENIC FREEZERS.
MORE QUALITY IN YOUR PRODUCTS.
MORE PRODUCTIVITY IN YOUR PLANT.

Holding or Storage Freezers for Frozen Dough

- Freezer temperature: - 10 to - 20°F (- 23 to 28°C).
- Poly- lined boxes - moisture loss.
- 12 to 16 weeks storage life (Bread and Rolls).

Cooling and Freezing Rates are Affected by:

- Specific heat
 - Porosity
 - Insulation value
 - Water content
- Symmetry - size and shape
- Difference in temperature
- Packaging

Processing of Frozen Dough

No-Time Dough – Most Used Dough System

Reasons:

- Best yeast survival - lowers yeast activation and thus, longer frozen shelf life.
- Shortest processing time - scheduling.
- Least amount of equipment - lowers capital cost.
- Most yield per pound of flour lowers unit cost.

Formula Adjustments for Frozen Yeast Leavened Doughs

- Flour - increase protein .5 to 2.0%.
- Decrease in ash content
- Water - decrease 1 to 4%.
- Yeast - increase 50 to 100%.
- Salt - normal levels to .25% increase.
- Sugar - normal to 1 - 3% increase.
- Shortening - normal to 2% increase.

Formula Adjustments for Frozen Yeast Leavened Doughs

- Continued

- Dough dryers - add calcium peroxide.
- Dough strengtheners - increase levels of S.S.L., C.S.L., DATEM's, etc. (Stay within legal limits)
- Crumb softeners - increase mono and diglycerides.
- Oxidation - ascorbic acid - 40 to 80 ppm (200ppm), ADA 0 to 40 ppm.
- Reducing agents - L-Cysteine 0 to 40 ppm.
- Acids/sours/flavors - possible add for increased flavor.

Frozen Dough Processing

- Mixing - to development, complete hydration
NOTE: Do not overmix.
- Dough temperature - 62 to 68°F
(17 to 20°C)
- Fermentation time - 0 to 10 minutes (Floor time)

Make-Up of Frozen Doughs

- Stiffer doughs - less absorption and lower dough temperature.
- Divider - higher ram pressure, less dusting flour.
- Sheeter - more open to prevent tearing.
- Moulder - less dusting flour for proper seaming.
- Batch production time - about 15 minutes.

Thawing Frozen Dough

Method #1

- Thaw in 40°F retarder for 12 - 18 hrs.
- Place at room temperature for 30 min.
- Proof at 100 to 105°F (38 to 41°C),
70 to 75% R/H for 1 to 1 1/2 hrs.

Thawing Frozen Dough

Method #2

- Take from freezer, place in baking pans.
- Proof at 80 to 85°F (27 to 29°C),
70 to 75% R/H for 2 to 3 hrs.

Thawing Frozen Dough

Problems

- Drying of dough surface.
- Excess R/H in proofer.
- Blisters on surface.
- Thawing and refreezing of dough.
- Storage temperature fluctuation.

Pre-Proofed Frozen Dough

Advantages:

- Longer shelf life (over 1 year).
- Better overall control of finished product.
- Less processing time and skill needed at retail.
- No thawing needed.

Focus: Keep all dough water “bound” through gentler makeup.

Products: Croissants, hearth breads, danish

Changes That Take Place During Freezing of Frozen Baked Products

- Product staling - starch retrogradation.
- Rancidity - fats.
- Moisture loss - dehydration (white ring).

Wrapped vs. Unwrapped

Product	Freezing Time (minutes)	
	Unwrapped	Wrapped
Dinner rolls	44	66
Cinnamon rolls	40	60
Cake donuts	8 1/2 (single)	47 (boxed)
Yeast donuts	6 (single)	37 (boxed)
Apple pie	128	300
Cherry pie	80	222

Recommended Freezing and Storage Conditions for Baked Product

- Minimum packaging material.
- Freeze soon after packaging.
- Fast freeze.
- Provide air movement over product.
- Space product.
- Freeze to + 20°F (-6°C) core temperature.
- Maintain uniform storage temperature.

Thawing of Baked Products

Objective: Bring product through critical temperature zone for staling as rapidly as possible.

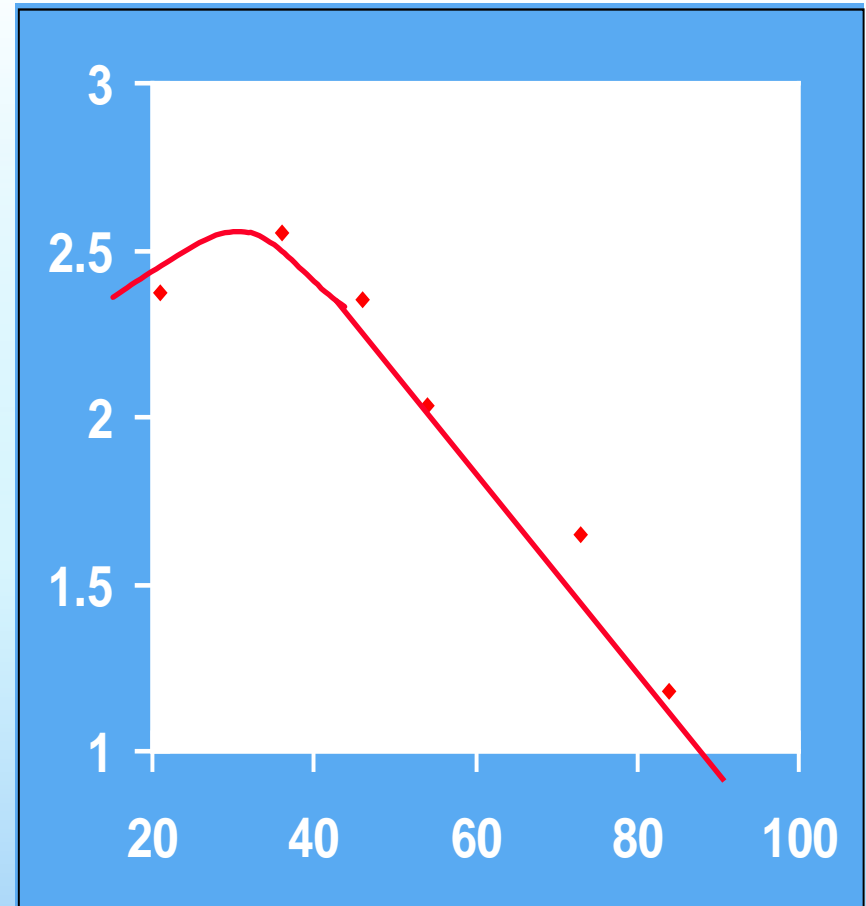
Major Problems: Condensation, incomplete thaw.

Consideration/Requirements:

- Relative humidity
- Air Flow
- Temperature

The relation of temperature to the estimated average rate of firming of a commercial white pan bread.

Estimated Firming Rate
g/4 mm. Comp./hr



Temperature in °F

Ideal Thawing Conditions

- Temperatures: 110 - 150°F (43 - 66°C)
- Humidity: 50 - 60% relative humidity.
- Air Velocity: 200 - 500 F.P.M.
- Time: variable.

Average Freezing Point Values of Baked Goods

- White bread + 22°F (-6°C) plus or minus.
- Sweetdough + 13°F (-10°C) plus or minus.
- Danish pastry + 5 to 10°F (-15 to -12°C)
- Cheese cake + 28°F (-2°C) plus or minus.
- Chiffon cake + 18°F (-8°C) plus or minus.

Freezing Equipment

Mechanical

- Best control in product temperature.
- Most cost-effective to operate.

Cryogenic

- Lower capital investment.
- Less product moisture loss.
- Smaller ice crystals.

Plate

- Slow freezing, \approx 1 inch of product per hour.

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