Managing Dry Grain in Storage

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Six causes of storage problems

- Too much foreign matter and fines
- Grain too Warm
- Grain too Wet
- Uneven grain temperatures
- Storage facility not cleaned before harvest
- Grain not checked often enough

Too much foreign matter & fines

- Screen before drying
- Screen before storage
  - Less volume to dry
  - Increased air flow in dryer
  - Fines plug screens and aeration floors
  - Insect / Mold growth in fines

- Spreader in Bin
  - Evenly distributes seed and fines

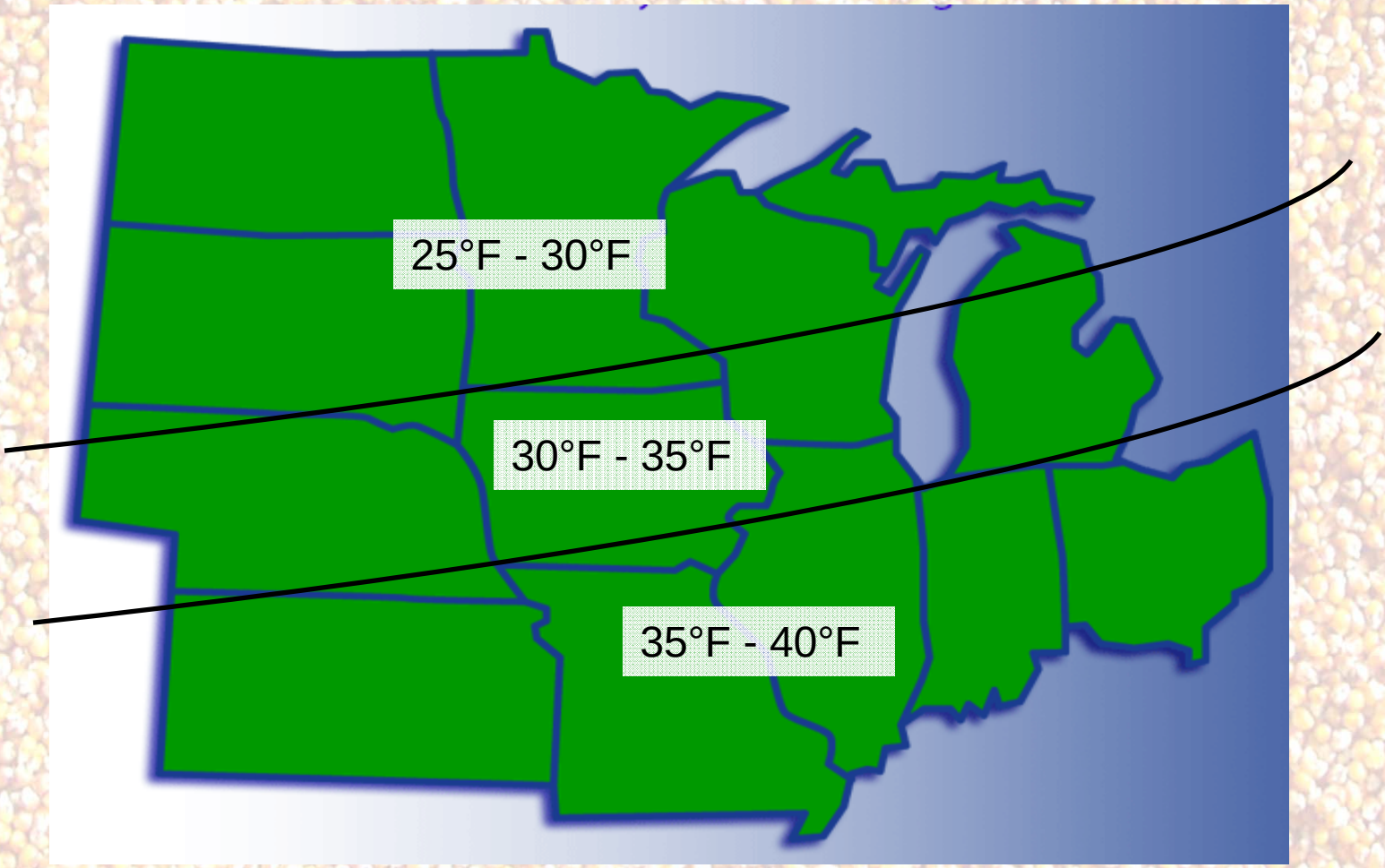
Perforated augers

Rotary Drum Screen

Grain too Warm

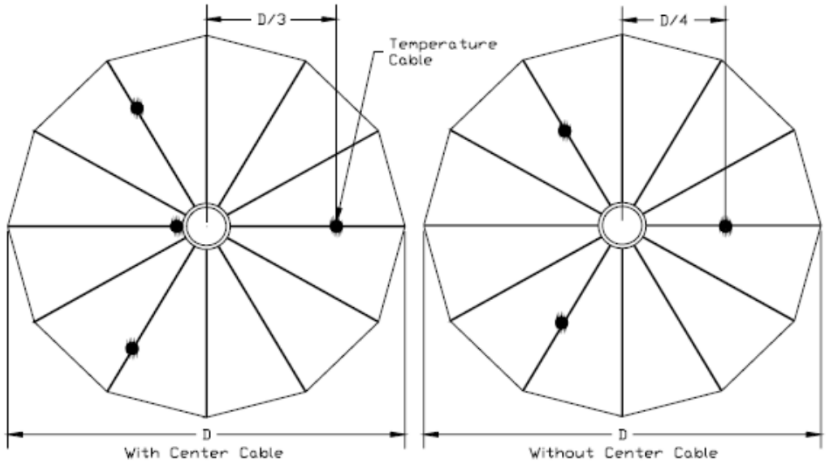
- Grain temperature within 10 – 15F of average daily temperature
  - So condensation doesn't occur
- Summer Storage temperature
  - 50°F in upper midwest
  - 60°F in southern US
- Winter storage temperature
  - 30 to 35°F in southern WI
  - 25 to 30°F in northern WI

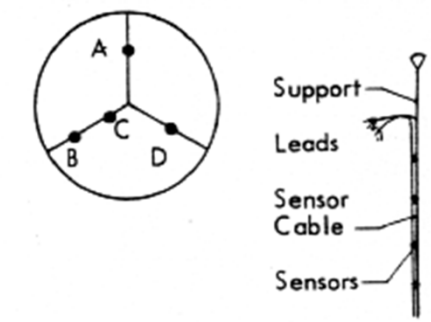
Suggested Winter Grain Storage Temperatures

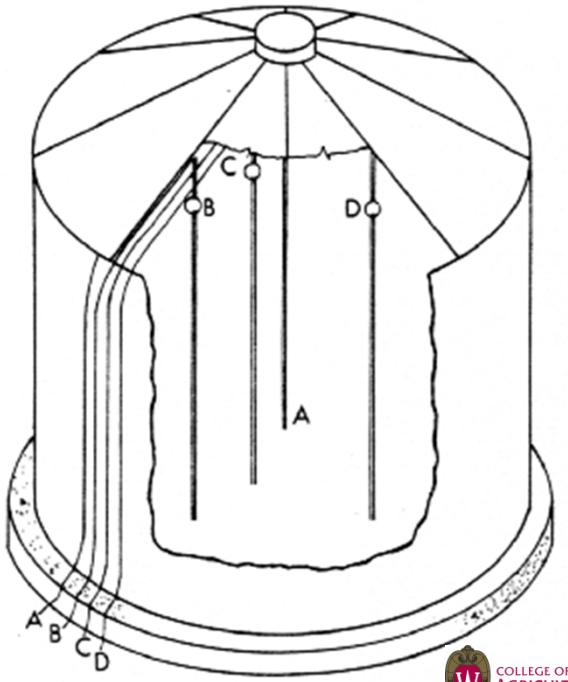


Temperature Measurement

Temperature Cable locations







- Temperature changes can be small and indicate a problem (1-2°F)
- Log data for reference
- Compare same locations over time to detect problem areas

Temperature monitoring

Normal Temperature Profile**

			Sensor							
Date	**Bin**	**Cable**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
5 Dec	1	1	26	26	27	27	25	27	32	32
11 Dec	1	1	26	25	26	27	27	27	25	26
17 Dec	1	1	27	25	27	28	27	28	34	34
23 Dec	1	1	27	26	27	27	27	29	32	33

** Sensor 7 & 8 not covered with grain

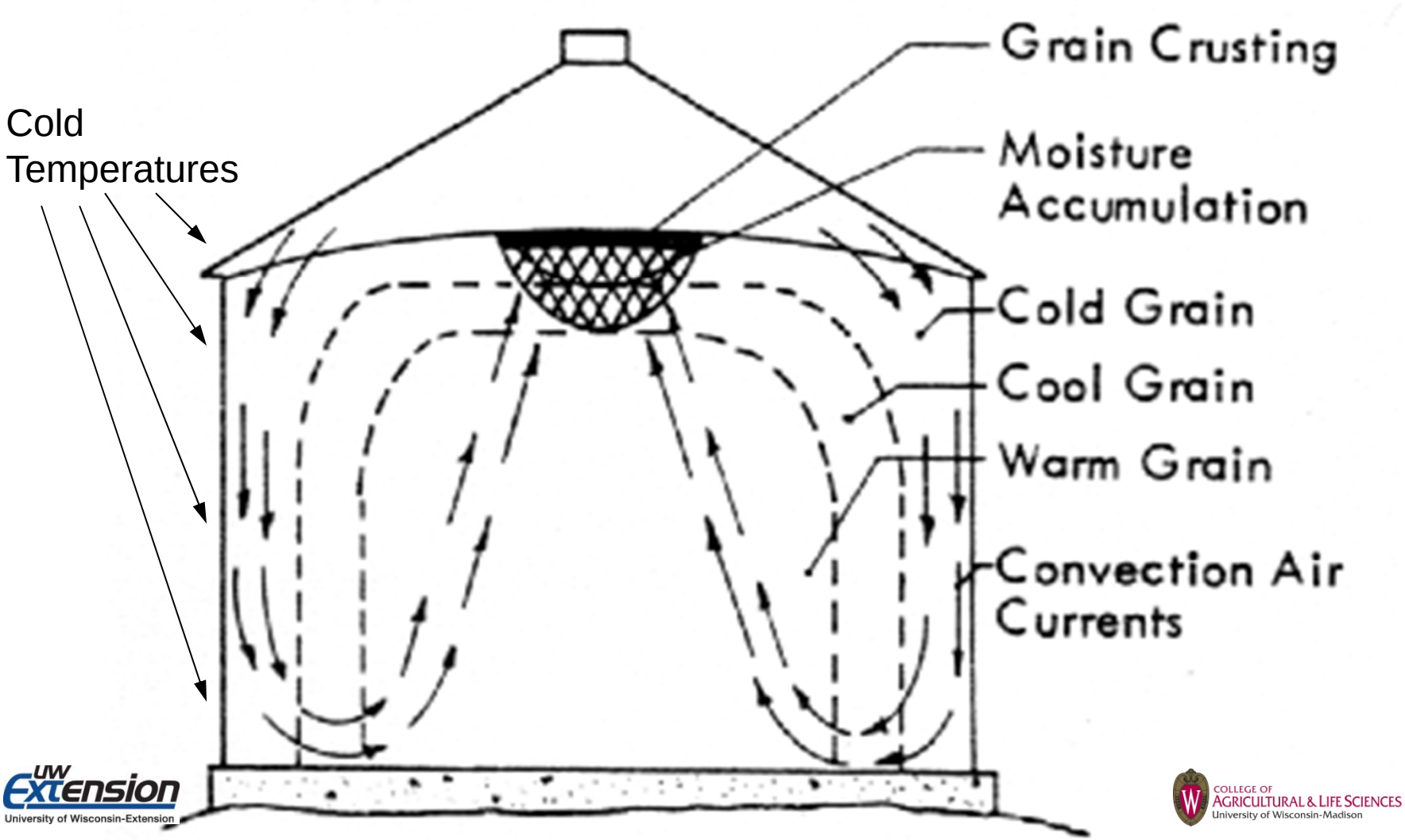
Hot Spot Temperature Profile

			Sensor							
Date	**Bin**	**Cable**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
5 Dec	1	1	29	28	29	30	31	30	31	32
11 Dec	1	1	29	28	29	32	31	31	32	29
17 Dec	1	1	30	29	30	33	32	31	33	32
23 Dec	1	1	31	29	30	35	32	31	33	35

Max. Grain Storage Moisture Percentage

	Storage Period (months)		
Crop	Up to 6 mos	6 to 12 mos	> 12 mos
Cereal Grains	14%	13%	13%
Canola	10	8	8
Corn	15	14	13
Soybeans	13	12	11
Sunflowers (oil type)	10	8	8
Edible Beans	16	14	13
Buckwheat	16	13	13

Uneven Grain Temperatures
Convection Air Movement



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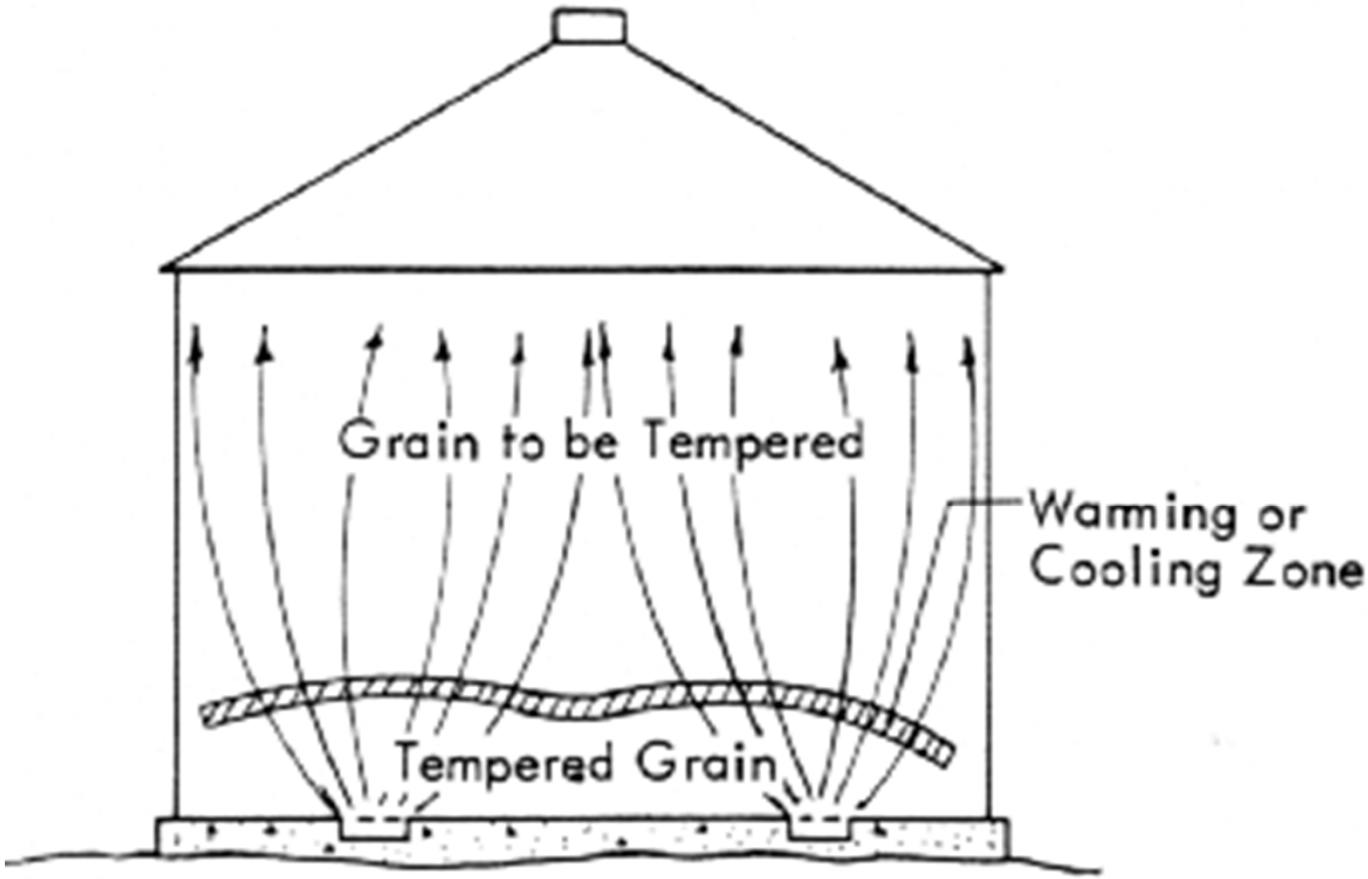
Aeration

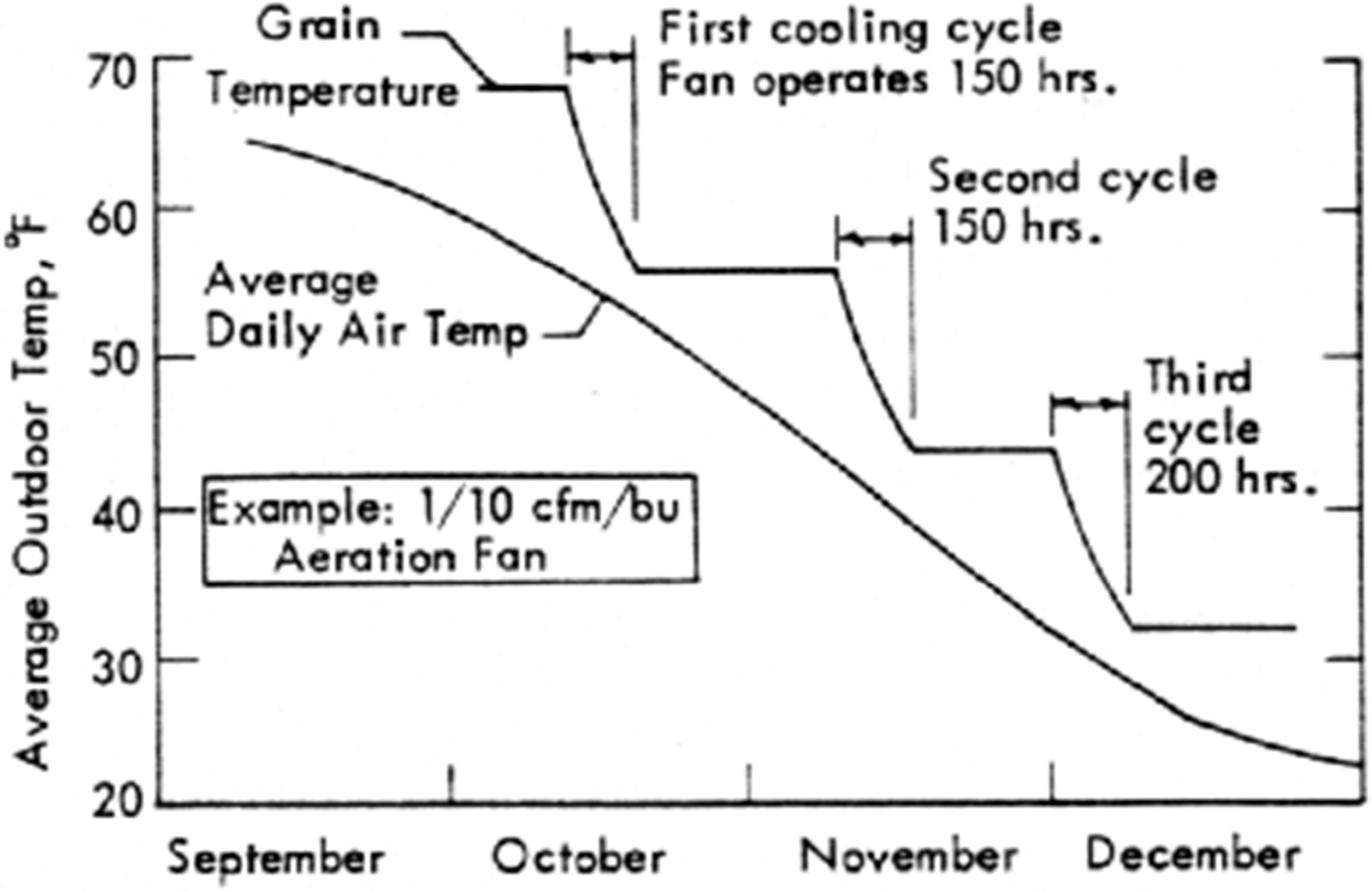
- Level grain surface
  - Distance of airflow path
- Aeration rate
  - Determines time requirement to change temperature
    - For a 10 - 15°F grain temperature change:
    - @ 0.05 cfm/bu = 280 hours vs 140 hours @ 0.1 cfm/bu
  - 0.1 cfm/bu (recommend for on-farm storage)
  - Higher aeration rates – take advantage of short periods of cool temperatures
- Cover fans when not in use
  - Rodent control, reduces convection air flow

Cooling / Warming Zone

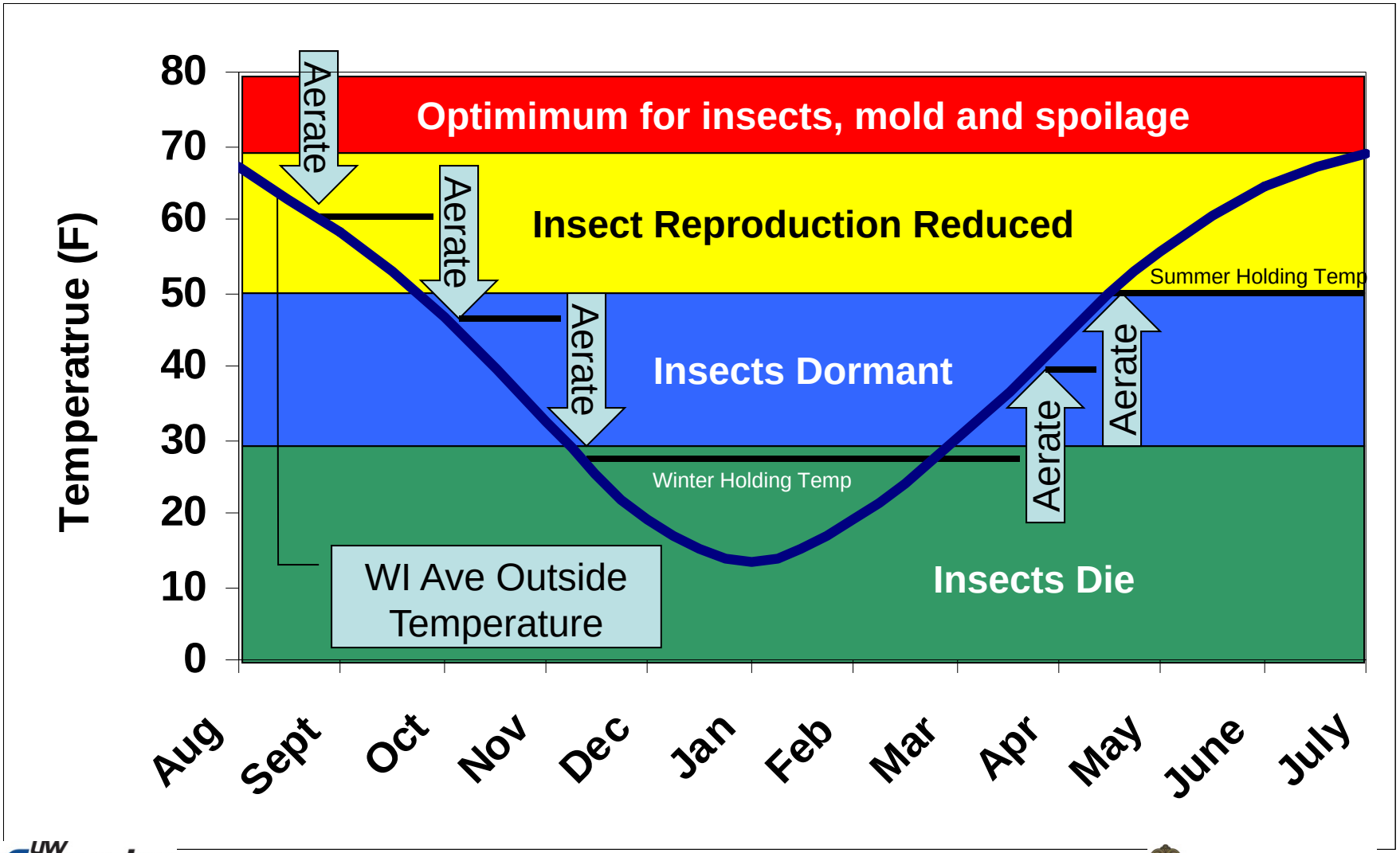


Positive pressure—cooling or warming zone moves up through the grain.

Cooling steps



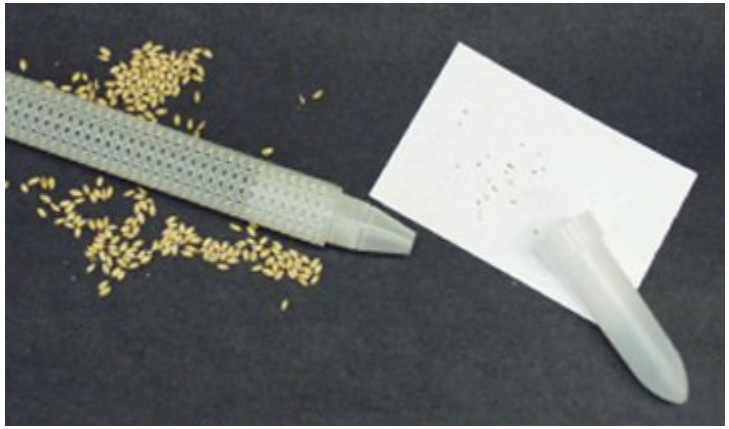
Cool Grain Prevents Storage Problems



Adapted from K. Hellevang, NDSU

Controlling Insects

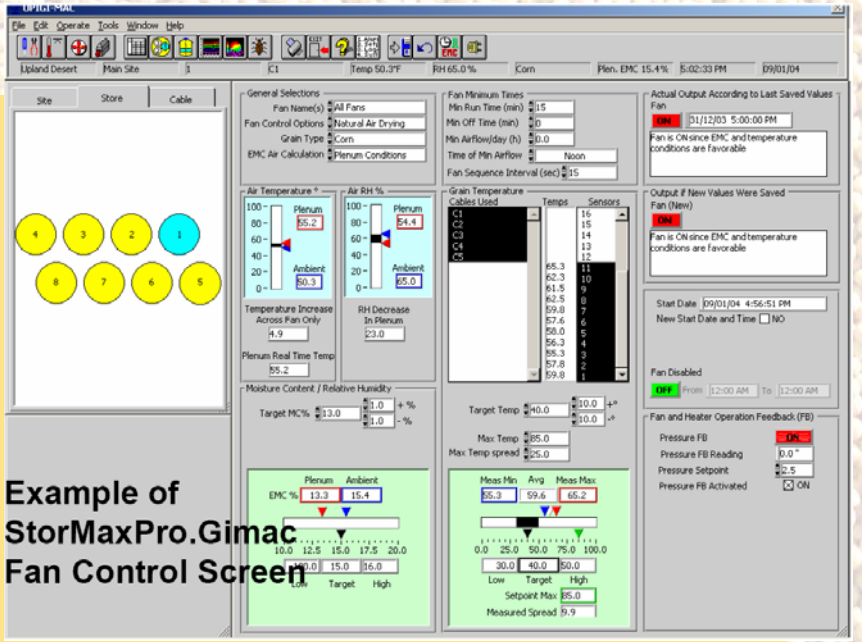
- Sanitation before filling bins – ***CLEAN BINS OUT***
- Temperature control < 50°F
- Detection
  - Probe Traps – 5 per bin
  - Sticky Traps
  - Pitfall traps
- Insecticides / Fumigants
  - Contact your buyer before applying



- References
  - Stored Product Pests, L.J. Mason, J. Obermeyer, Bulletin E-66-W, Purdue Extension, 2010. http://extension.entm.purdue.edu/publications/E-66.pdf
  - Controlling Insects in Stored Grain, D.W. Johnson, L.H. Townsend, Bulletin ENTFACT-145, University of Kentucky Extension, 2009. http://www2.ca.uky.edu/entomology/entfacts/entfactpdf/ef145.pdf
  - PJ Liesch – UW Insect Diagnostic Lab –
    - http://labs.russell.wisc.edu/insectlab/

Temperature / Fan Controls

- Thermostats
  - Hour meter – run time
- Microprocessor controls
- Computer-based controls
  - Archive data
  - Plot data
  - Accurate temperature settings
  - Monitor temperatures from office
  - Range of features and cost
  - <u>Does NOT eliminate the need to check bins</u>



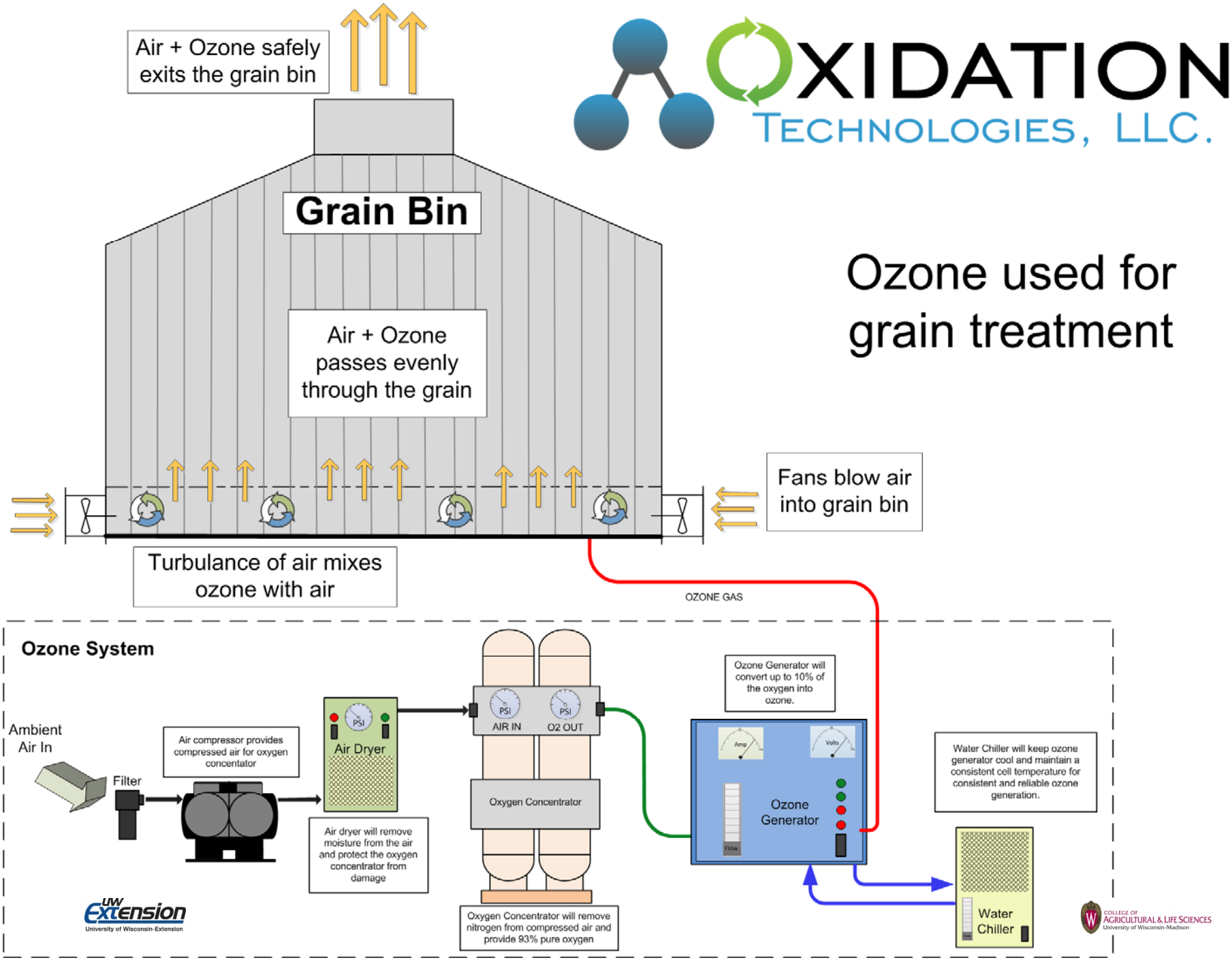
Example of StorMaxPro.Gimac Fan Control Screen

Inspection Monitoring Checklist

- Inspection frequency
  - 1 to 2 weeks during warm weather
  - 3 to 4 weeks during winter
- Turn on aeration fans
  - Ensure proper operation
  - Check static pressure in plenum
- Climb up and look inside bin
  - Condensation under roof, wet grain near hatches
  - Snow cover – run fans until sublimated
  - Check for off-odors
  - Check grain surface – crusting, mold
  - Measure grain temperatures at several locations
- Check for signs of insect, mold, rodent activity
- Record observations in logbook / Checklist
- Compare observations with previous findings
- Take any corrective action required

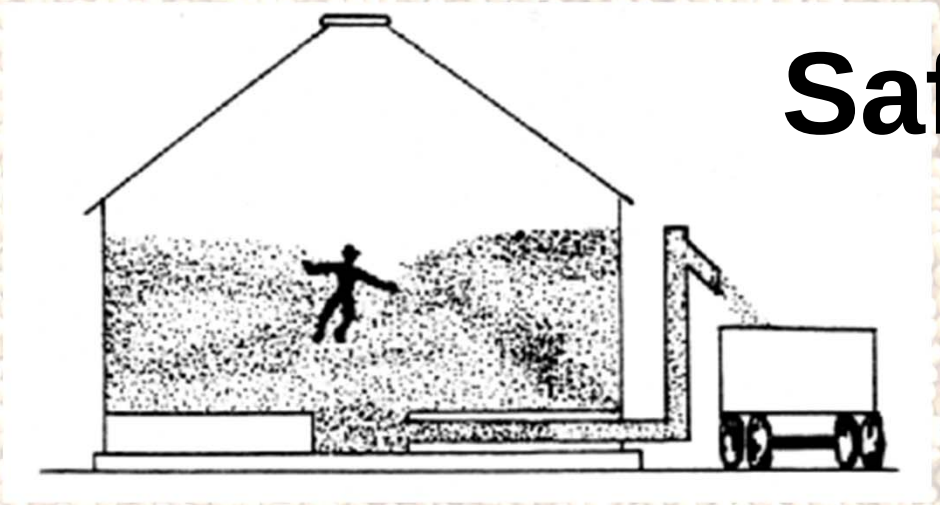
OXIDATION TECHNOLOGIES, LLC.

Ozone used for grain treatment



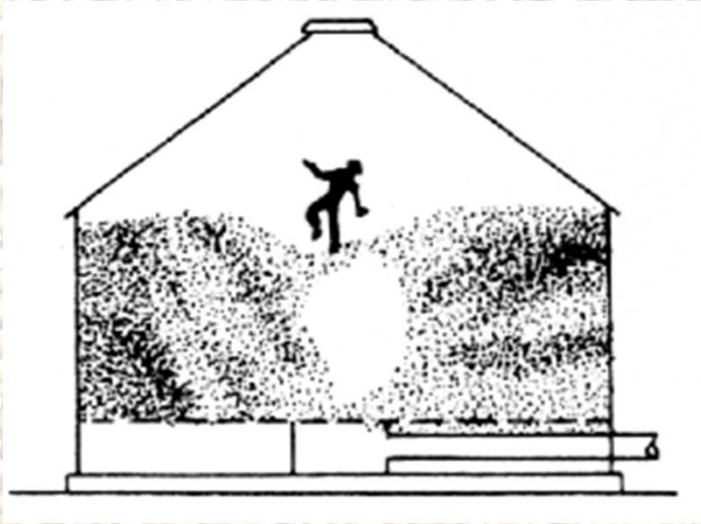
Ozone Technology

- Kills insects
  - Efficacy depends on
    - Insect species, life stage, O3 concentration
  - External feeders - Exposure 35 ppm for 6 days
  - Internal feeders – Exposure 135 ppm for 8 days
- Reduce micotoxin levels
  - Oxidizes toxins
- Stops Mold growth
- No residual effect
- Will NOT stop heating



Safety First!!!!

- Never enter a bin while unloading equipment is operating
- Lockout controls before entering bins
- Beware of potential cavities under crusted grain
- Use safety equipment
  - Harness
  - Respirator



Other Resources

- Managing Dry Grain in Storage, AED20, Midwest Plan Service, Ames, IA, 2004. (www-mwps.sws.iastate.edu)
- Dry Grain Aeration Systems Design Handbook, MWPS-29, Midwest Plan Service, Ames, IA, 1999.
- Grain Drying, Handling and Storage Handbook, MWPS-13, Midwest Plan Service, Ames, IA, 1987.

- Stored Product Protection – Cost of Good Sanitation Practices for On-Farm Grain Storage, GQ-50-W, Purdue Extension, 2008.
  - https://www.extension.purdue.edu/extmedia/gq/gq-50-w.pdf
- North Dakota State U. – Post harvest resource links
  - https://www.ag.ndsu.edu/graindrying
- U. of Minnesota – Post Harvest Crop Handling
  - http://bbe.umn.edu/postharvest

Ozone Treatment Resources

- Hansen, L. S., Hansen, P. and Jensen, K.-M. V. (2012), Lethal doses of ozone for control of all stages of internal and external feeders in stored products. Pest. Manag. Sci., 68: 1311–1316. doi: 10.1002/ps.3304
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- B.K. Tiwari, C.S. Brennan, T. Curran, E. Gallagher, P.J. Cullen, C.P. O' Donnell (2010), Application of ozone in grain processing, Journal of Cereal Science, 51: 248-255.

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