Comparison of Temperature Distribution during Heat Treatments using TempAir or Aggreko Systems[1]

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Because of the increasing interest in using high temperature to manage insects in food processing facilities, a demonstration project was conducted in the pilot cleaning house and flour mill at Kansas State University. The flour mill has been heated three or four times per year since 1995 whereas Dr. Pedersen had previously heated the cleaning house only in 1995.

Two heating systems were used during heat treatments on June 25-27 and on August 4-6, 1999. The TempAir (Burnsville, MN) system was used during the June treatment while the Aggreko (New Iberia, LA) system was used during August. The TempAir system heats air from outside the building and delivers it inside through cloth ducting. This creates positive pressure within the building that results in heated air being forced out of cracks and other openings. The Aggreko system consists of electric heaters located within the facility with power and monitoring cables running to a control trailer outside. The Aggreko system heated air within the building and did not duct additional air into the structure. Both systems use fans to facilitate air circulation during the heat treatments.

HOBO (Onset Computer Corp., Pocasset, MA) temperature loggers were distributed at floor level in the cleaning house and flour mill in a loose grid fashion using 16 to 22 per floor in each room. To accurately compare the temperature distribution and heating dynamics during the two heat treatments, the temperature loggers were placed in the same places each time. The loggers recorded at 10-minute intervals during the heat treatment. Maps of the temperature distributions and differences between the two heat treatments were made using Surfer for Windows (Golden Software, Golden, CO).

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[1] This is a report of research results only. Mention of a proprietary product does not constitute an endorsement by USDA or Kansas State University at the exclusion of other products.

Table 1. *The length of time and the time to reach target temperature of 50°C (122°C) (±SEM) and the maximum temperature attained during the heat treatment of the cleaning house and flour mill at Kansas State University using the TempAir system, June, 1999.*

Room	Floor	Time above 50°C (hr)	Time to reach 50°C (hr)	Maximum Temperature (°C)
Cleaning house	1	27.5 ± 2.6	11.7 ± 4.2	57.9 ± 1.2
	2	23.0 ± 2.4	14.9 ± 2.1	56.6 ± 1.3
	3	21.4 ± 2.4	19.7 ± 2.3	55.4 ± 0.8
	4	17.8 ± 2.0	23.2 ± 2.5	53.8 ± 0.5
Flour mill	sub floor	13.2 ± 3.4	23.7 ± 4.4	53.3 ± 1.2
	2	22.6 ± 2.9	16.3 ± 3.3	59.1 ± 2.1
	3	28.2 ± 1.2	14.0 ± 1.0	57.7 ± 0.5
	4	22.9 ± 2.0	19.3 ± 2.0	55.3 ± 0.6
	5	22.4 ± 2.3	20.0 ± 2.0	55.1 ± 0.6

Table 2. *The length of time and the time to reach target temperature of 50°C (122°C) (±SEM) and the maximum temperature attained during the heat treatment of the cleaning house and flour mill at Kansas State University using the Aggreko system, August, 1999.*

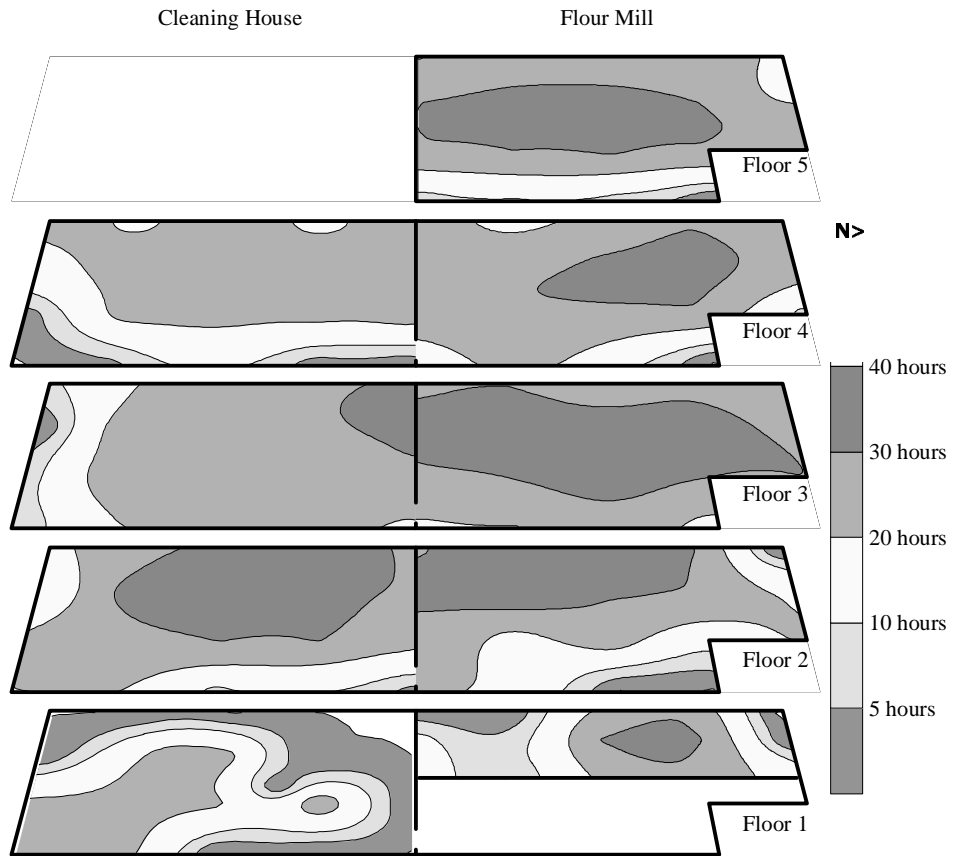| Room	Floor	Time above 50°C (hr)	Time to reach 50°C (hr)	Maximum Temperature (°C)
Cleaning house	1	20.5 ± 3.7	5.2 ± 2.0	53.6 ± 1.4
	2	24.3 ± 4.4	19.1 ± 3.9	54.3 ± 1.4
	3	27.1 ± 3.3	20.9 ± 4.2	53.9 ± 0.6
	4	26.0 ± 2.7	9.7 ± 1.8	53.6 ± 0.7
Flour mill	2	20.0 ± 3.0	10.0 ± 2.0	53.3 ± 1.1
	3	30.0 ± 2.2	7.7 ± 1.4	54.7 ± 0.8
	4	24.2 ± 2.9	8.7 ± 1.5	53.9 ± 1.1

Figure 1. The length of time (hours) the temperature was above 50°C during the June, 1999 heat treatment in the cleaning house and flour milll at Kansas State University.
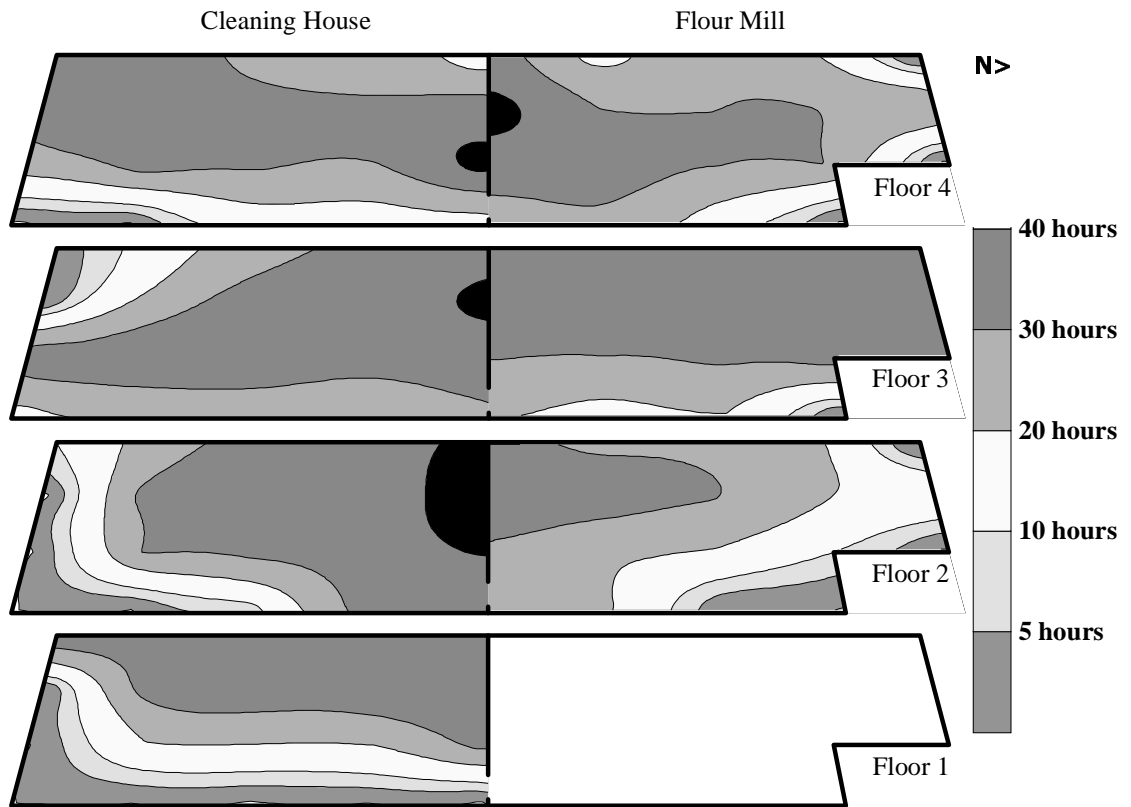
Cleaning House   Flour Mill

N>

Floor 4

40 hours

30 hours

Floor 3

20 hours

10 hours

Floor 2

5 hours

Floor 1

Figure 2. The length of time (hours) the temperature was above 50°C during the August, 1999 heat treatment in the claening house and flour mill at Kansas State University.
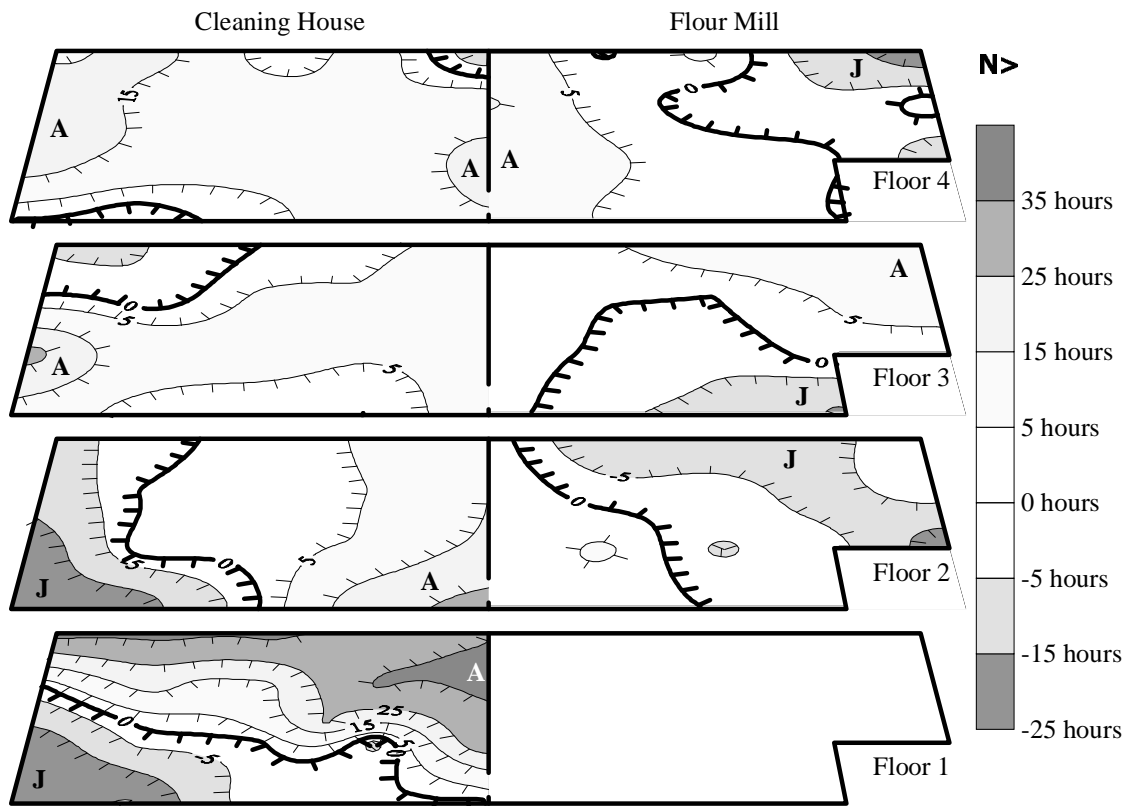
Cleaning House   Flour Mill

N>

A   A A   J   Floor 4

35 hours

25 hours

A   A   Floor 3

15 hours

A   J

5 hours

0 hours

J   A   J   Floor 2

-5 hours

-15 hours

A

-25 hours

J   Floor 1

Figure 3. The difference in the length of time (hours) the temperature was above 50°C during heat treatments in June and August, 1999 in the cleaning house and flour mill at Kansas State University. Negative values indicate longer heating in June than in August, positive values indicate longer heating in August than in June; A = longer in August; J = longer in June.

Cleaning House   Flour Mill

Floor 5

N>

50 hours

30 hours

Floor 4

20 hours

15 hours

Floor 3

10 hours
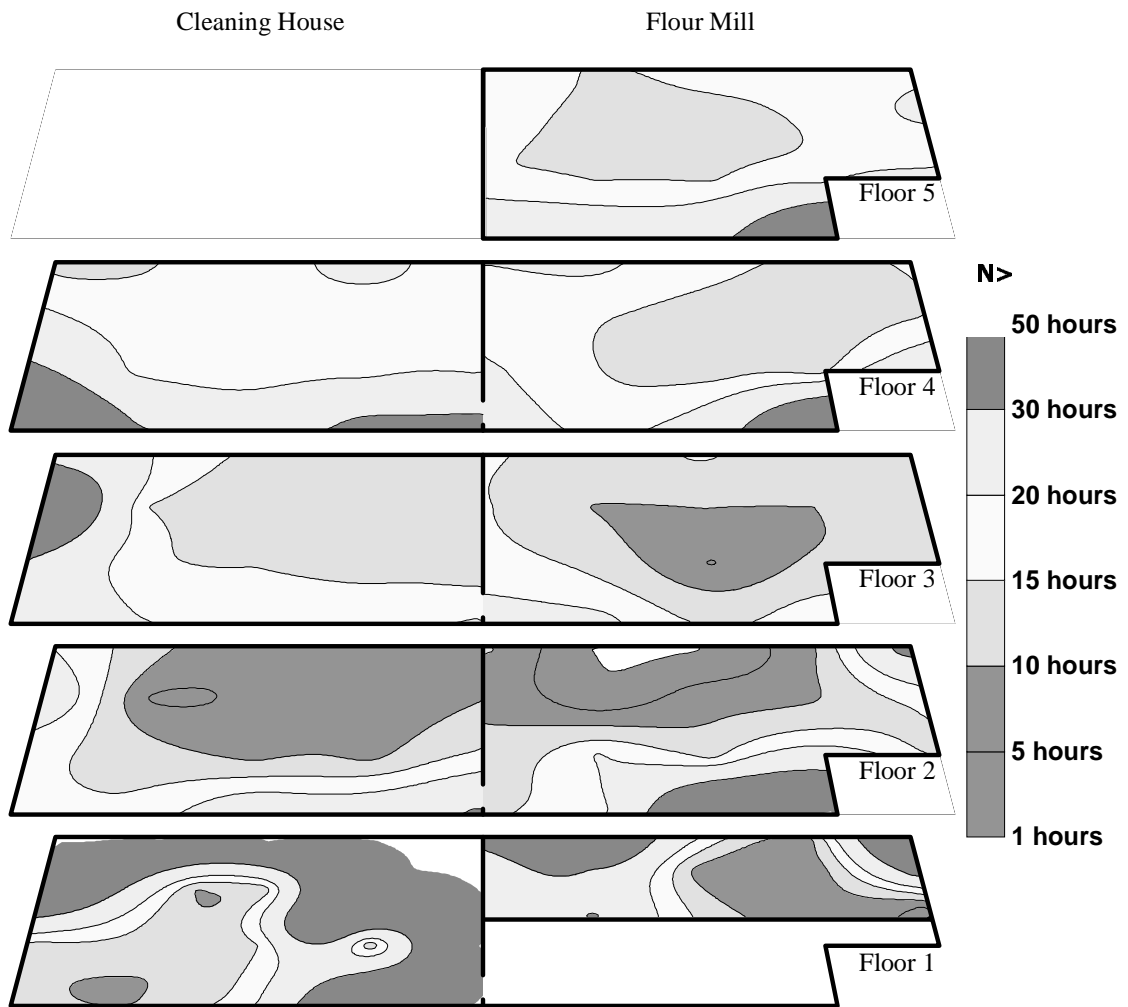
5 hours

Floor 2

1 hours

Floor 1

Figure 4. The length of time (hours) to reach the target temperature of 50°C during the June, 1999 heat treatment in the cleaning house and flour mill at Kansas State University.
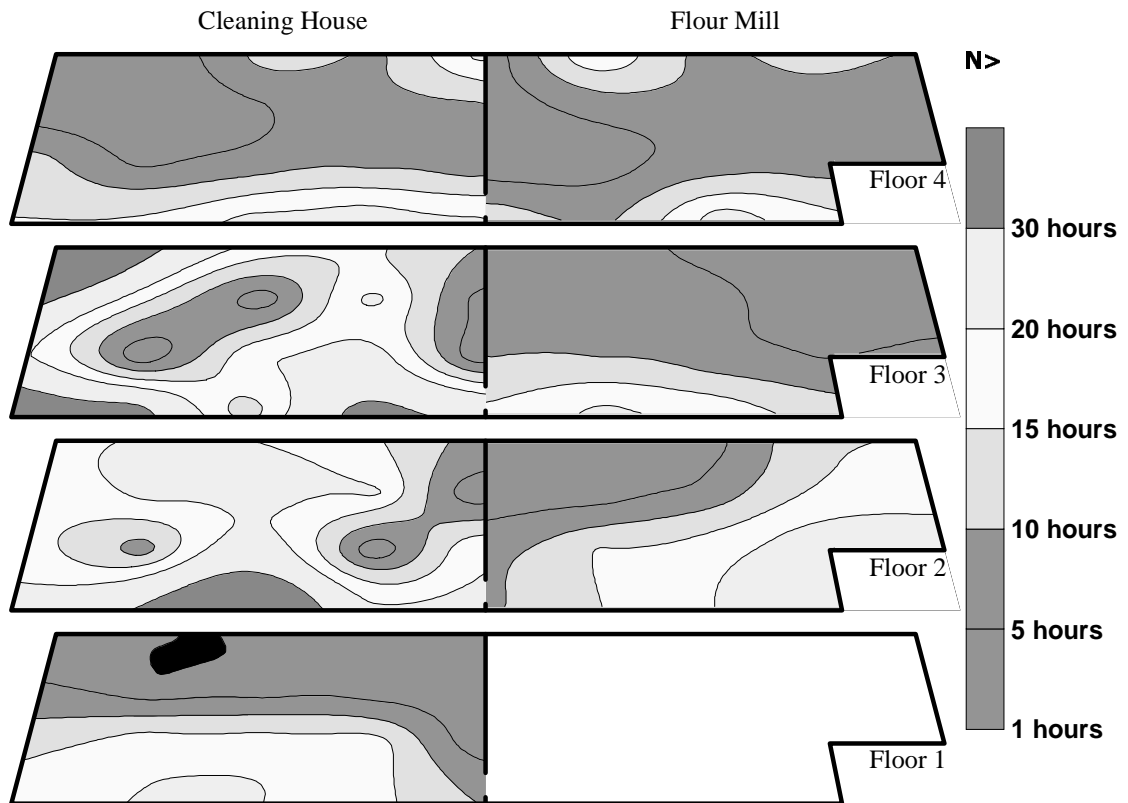
Cleaning House   Flour Mill   N>

Floor 4

30 hours

Floor 3

20 hours

15 hours

Floor 2

10 hours

5 hours

Floor 1

1 hours

Figure 5. The length of time (hours) to reach the target temperature of 50°C during the August, 1999 heat treatment in the cleaning house and flour mill at Kansas State University.
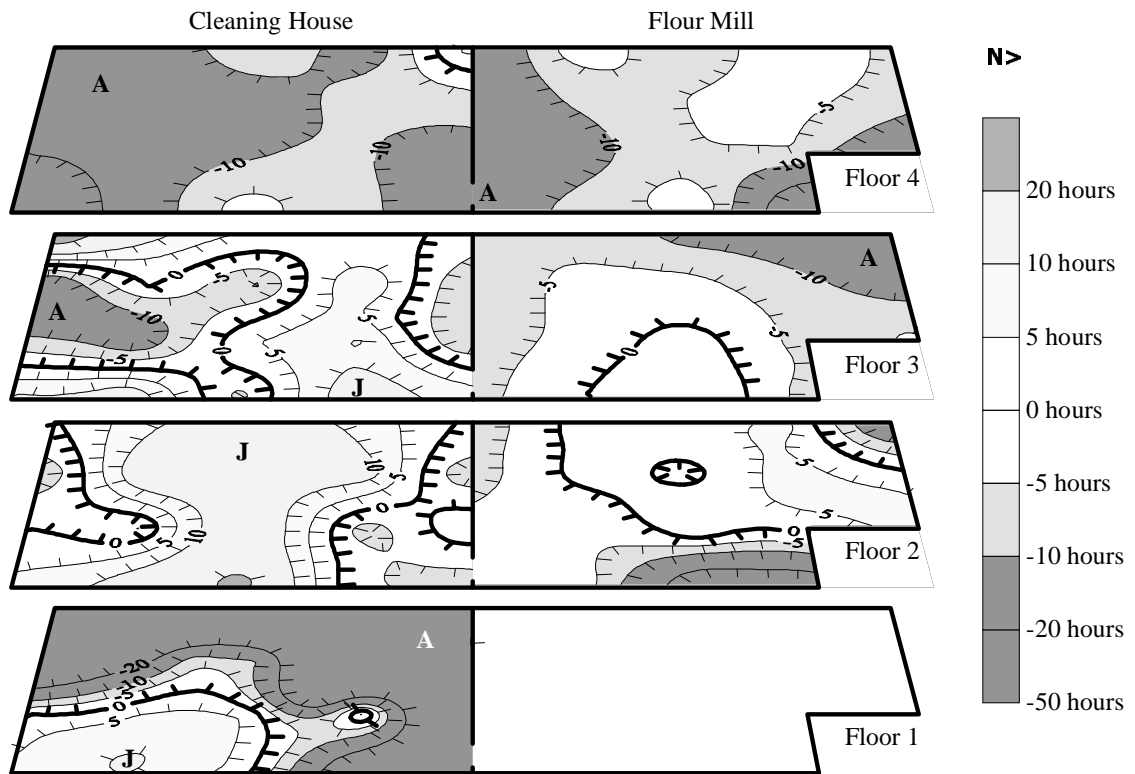
Figure 6. The difference in the length of time (hours) to reach the target temperature of 50°C during heat treatments in June and August, 1999 in the cleaning house and flour mill at Kansas State University. Negative values indicate a more rapid rate of temperature increase in August than June; positive values indicate a more rapid rate of temperature increase in June than in August. A = more rapid increase in August; J = more rapid increase in June.
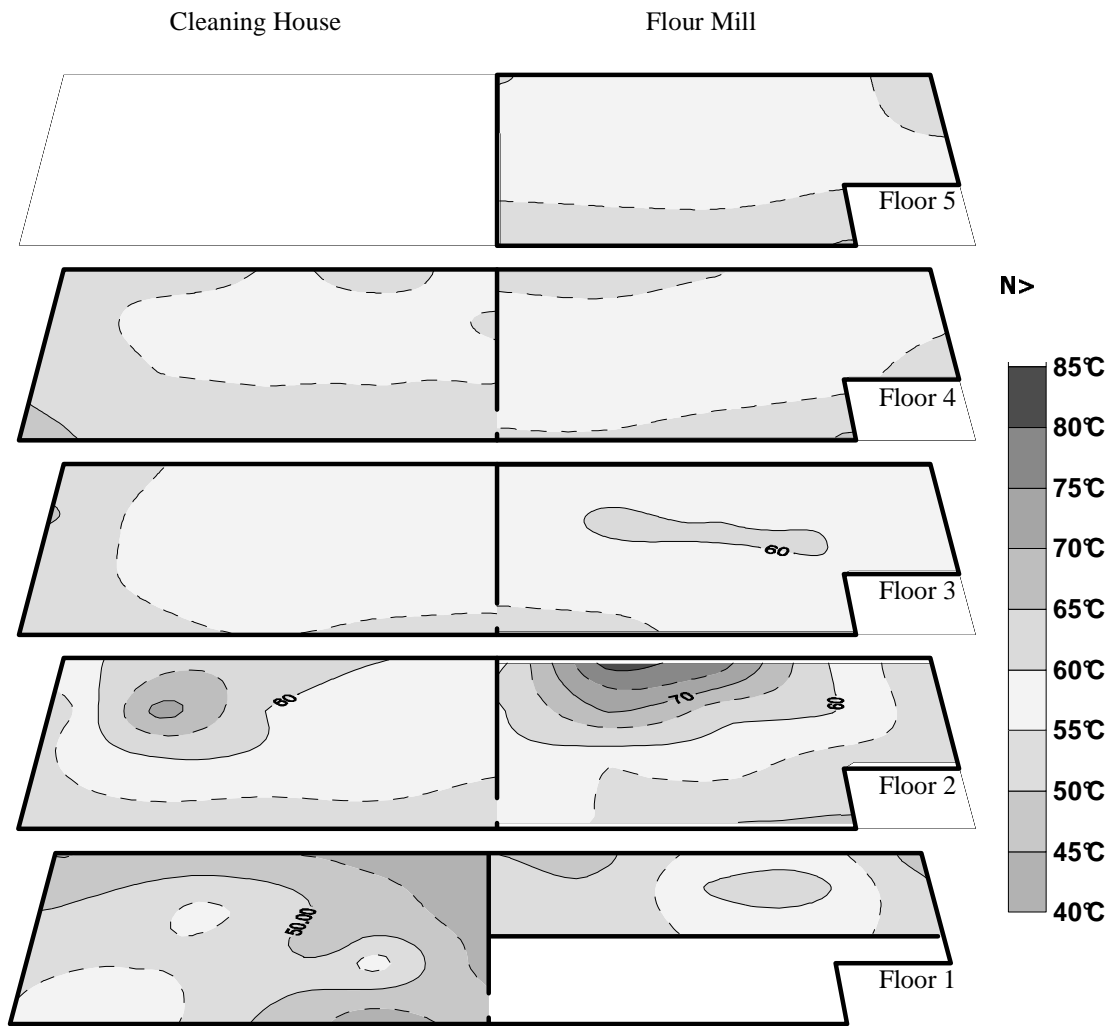
Cleaning House   Flour Mill

Floor 5

N>

Floor 4

85℃
80℃
75℃
70℃
65℃
60℃
55℃
50℃
45℃
40℃

Floor 3

Floor 2

Floor 1

Figure 7. The maximum temperature attained during the June, 1999 heat treatment in the cleaning house and flour milll at Kansas State University.

Cleaning House   Flour Mill

N>

Floor 4

Floor 3

Floor 2

Floor 1

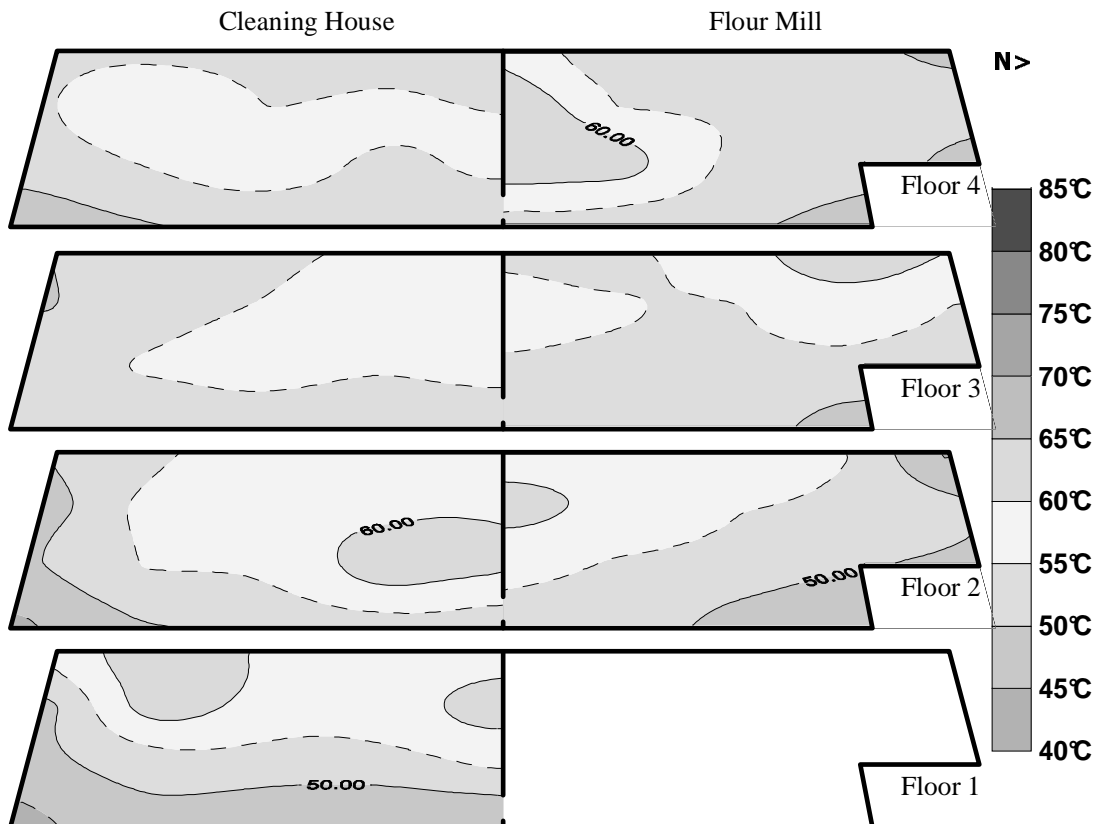85℃
80℃
75℃
70℃
65℃
60℃
55℃
50℃
45℃
40℃

Figure 8. The maximum temperature attained during the August, 1999 heat treatment in the cleaning house and flour mill at Kansas State University.
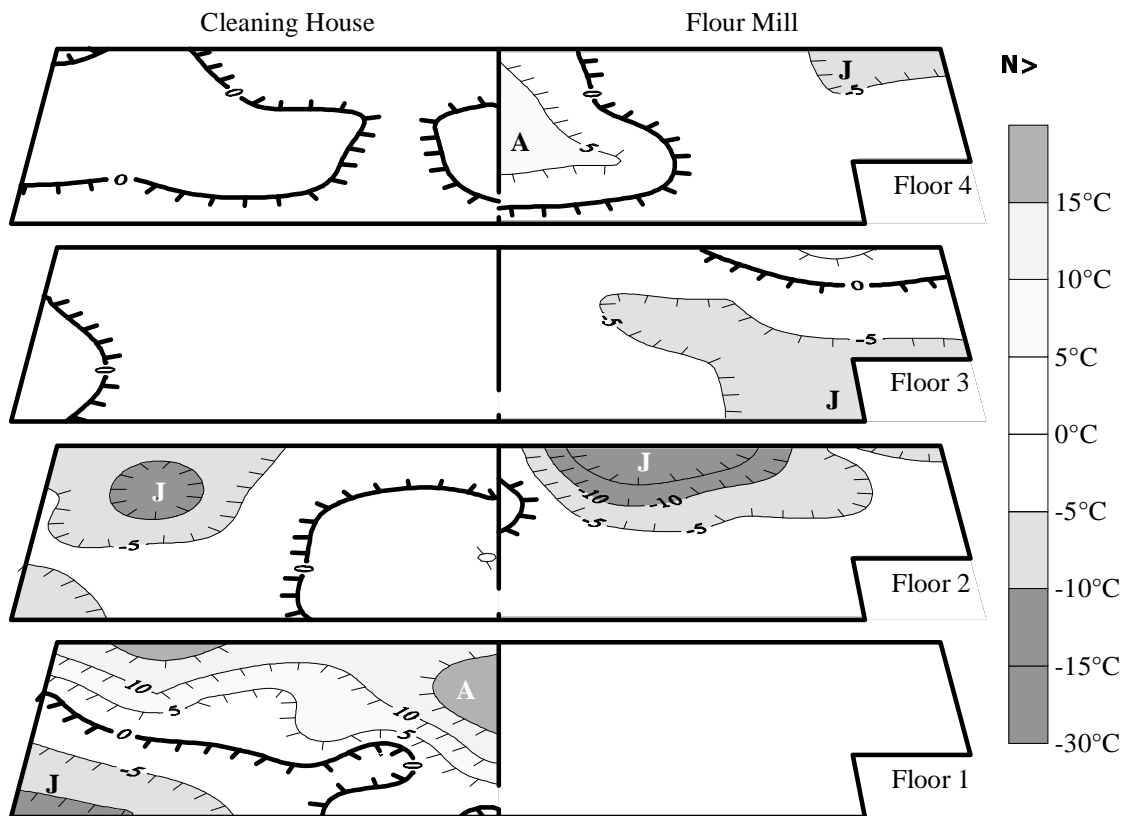
Figure 9. The difference in maximum temperatures attained during heat treatments in June and August, 1999 in the cleaning house and flour mill at Kansas State University. Negative values indicate cooler temperatures in August treatment; positive values indicate cooler temperatures in June treatment; A = warmer in August; J = warmer in June.