

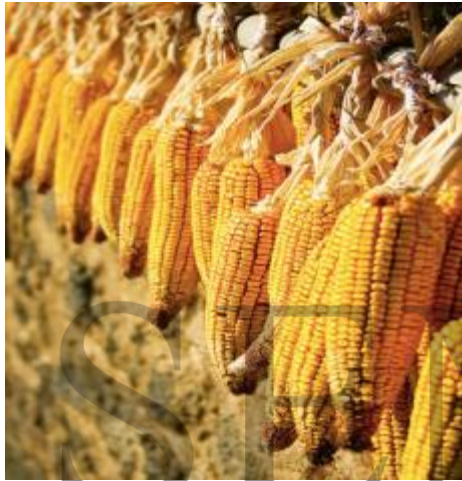
# Pre-Cleaning and Air-Screen Cleaning

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**192 Seed Science Center, email: [yshyy@iastate.edu](mailto:yshyy@iastate.edu)**

# Pre-Cleaning Operation:



- Before harvest



- Before cleaning



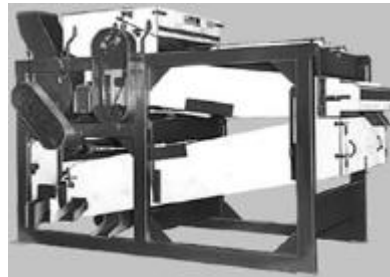
- After cleaning



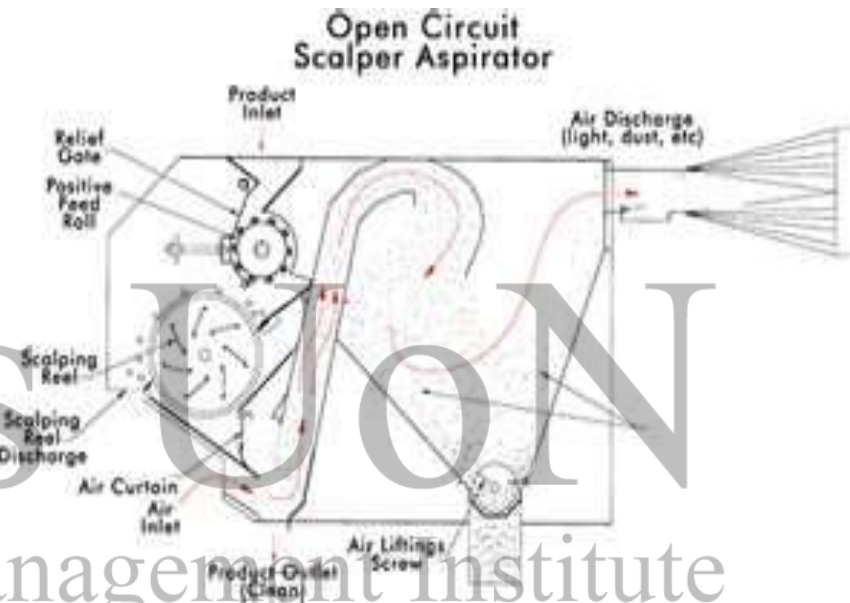
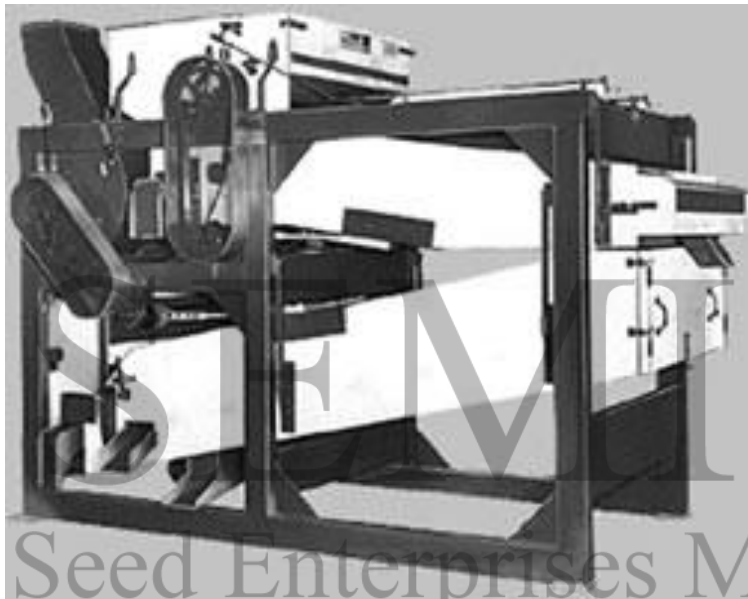
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# Pre-Cleaning Operation:

- Why?
  - Enough trash is removed to permit bulk storage and processing
  - Seed feed more evenly through down-stream equipment
  - High moisture, green material is removed decreasing time and cost of drying
  - Removal of bulk of trash permits finer top screens to be used resulting in precise separations
  - Cleaning machines are more efficient
  - Most commonly done by a **scalper**
- **What is a scalper?**



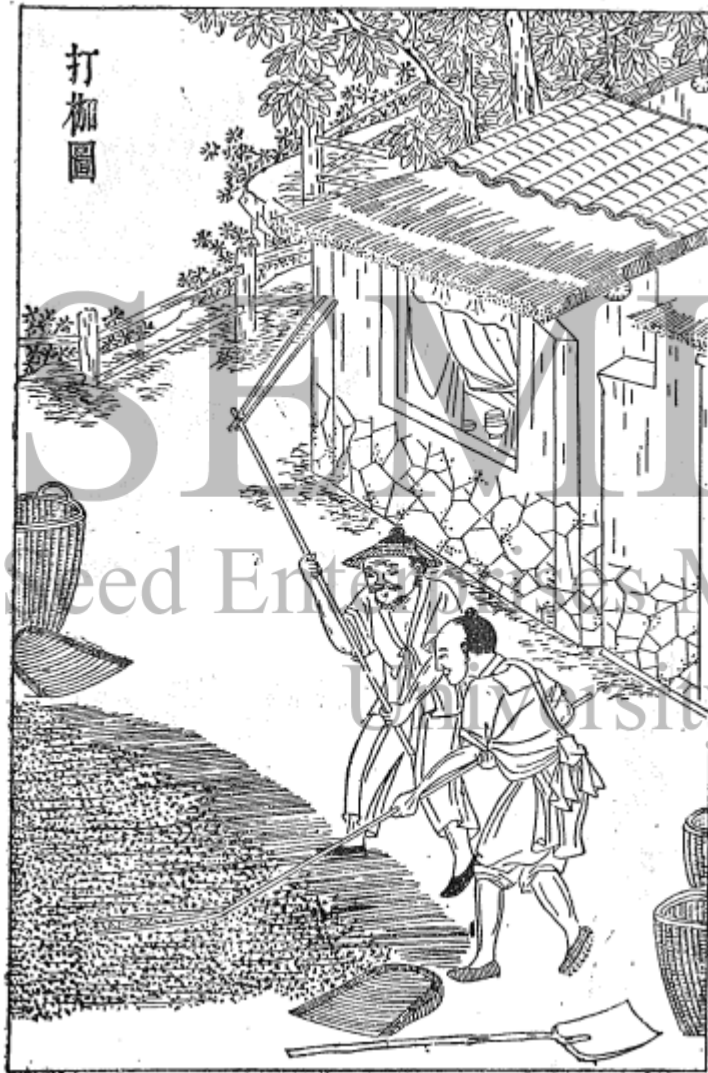
# Pre-Cleaning Operation:



Pre-cleaning air-screen cleaner, is designed for high capacity pre-cleaning and market cleaning of seeds. This model is designed for effective removal of light, large, and small waste. It begins with two screens that allow the top screen always serves as a scalper and the bottom screen functions as a sifter.

Aspirator can be used with scalper for both before and/or after product enters to pre-cleaning cleaner. It is also designed for high capacity removal of trash from seed.

# Pre-Cleaning Operation: 1,500 AC China



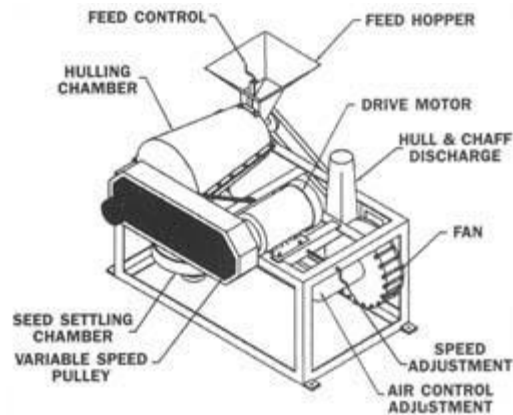
# Pre-Cleaning Operation:

- Debeaders:



- Seeds with awns, hairs or other chaffy appendages reduce flowability in cleaning equipment
- It removes these unwanted appendages with rotary and beating arms

- Huller-Scarifier



- Removes hull or pods and scarifies hard seeds
- Throws seed against sandpaper or rubber concaves
- Harsh process with potential for seed damage

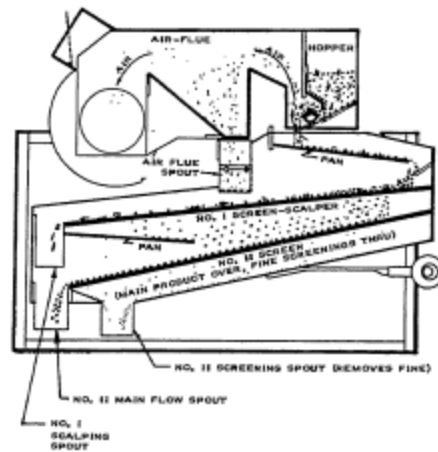
# Products after Pre-Cleaning:



- Seeds need to be precisely cleaned for improving quality and make it legal to sale as 'seed' - Germination, purity, health, and vigor
- Air-Screen Separator is the most common machine in the seed processing operation
- It combines the principles of screen and air separation. This combination of principles separates the over/under size and fine/light debris from the seed

# Air-Screen Cleaning

- Basic machine in most seed processing plants
- Combines air separation with sieve operations
- Based on differences in size and weight of seeds
- Three cleaning elements:
  - Aspiration: Removal of light material from the seeds
  - Scalping: Removal of oversize material from seeds
  - Sifting: Removal of undersize material from seeds



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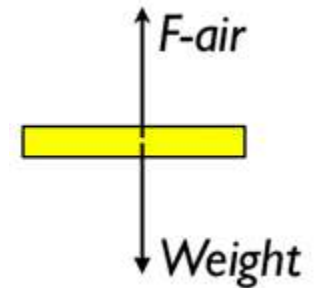
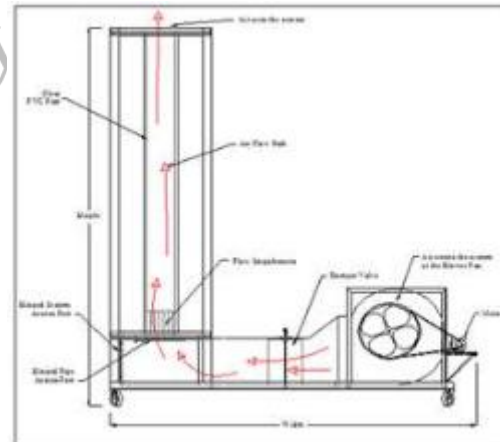
# Air-Screen Cleaning - AIR



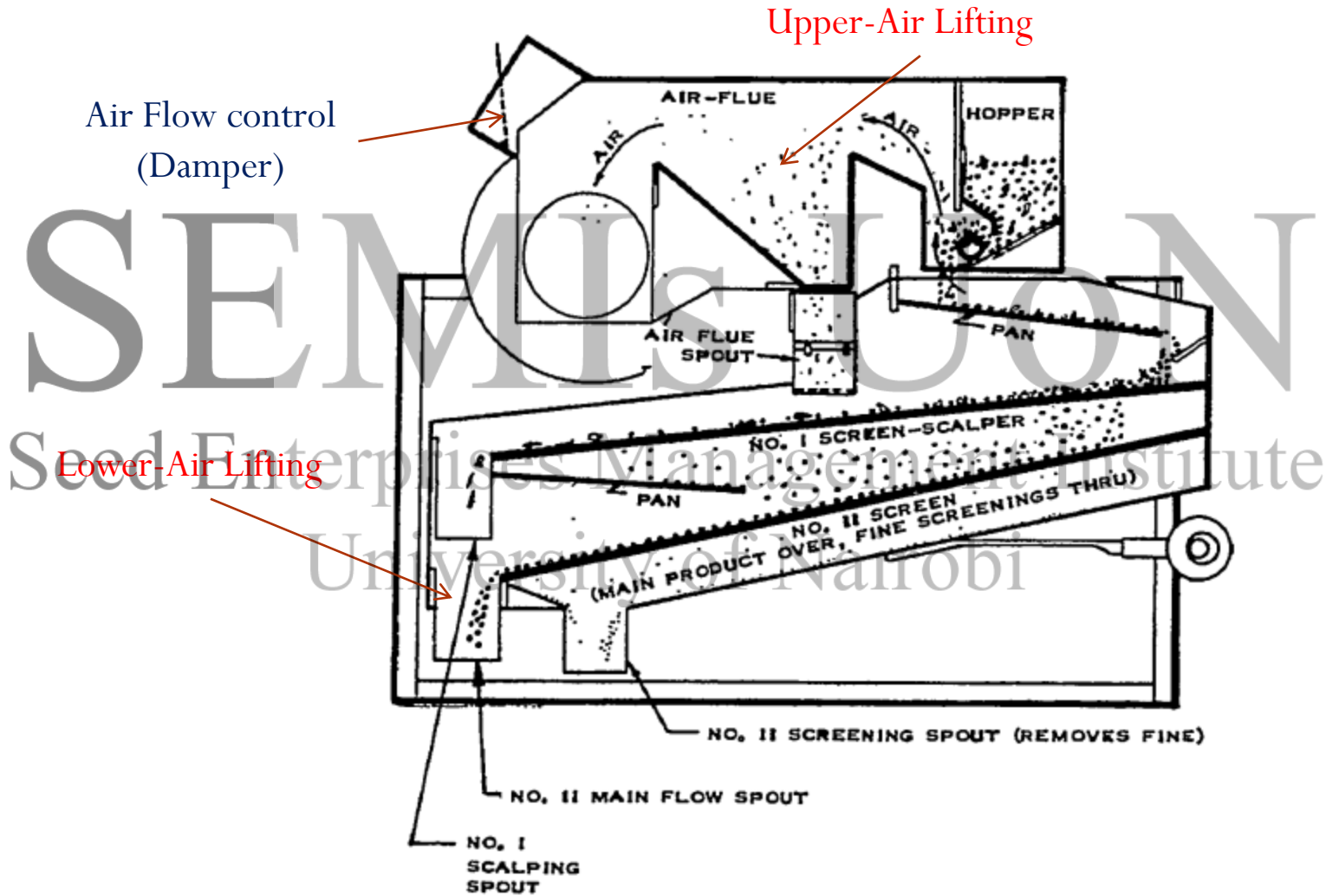
Air Separation, 1,500 AC China

- The air separation is based upon the terminal velocity difference of material
- The light material is removed from the seed by air flow since it has smaller terminal velocity
- How to measure 'Terminal Velocity'?

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# Air-Screen Cleaning - AIR



# Air-Screen Cleaning - SCREENING

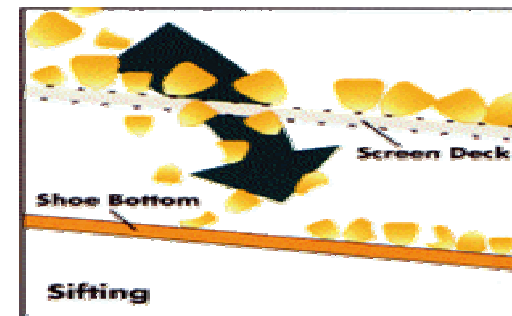


Screen Separation, 1500 AC, China

- Scalping: Good seeds are dropped through screen openings, larger material carried over screen



- Sifting: Good seeds ride over screens while small seeds drop through screen and moved to separate spout by shoe bottom



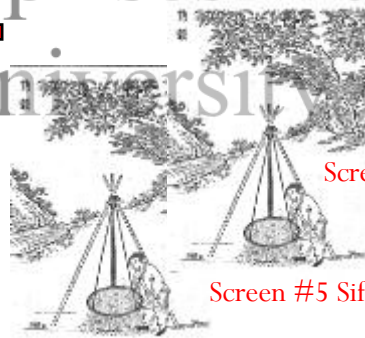
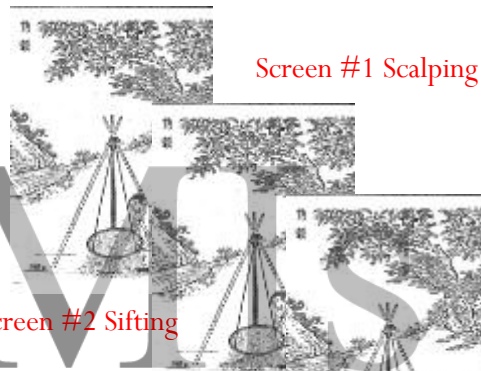
# Air-Screen Cleaning - Cleaner

Upper Air



Air Separation

Lower Air



Screen Separation

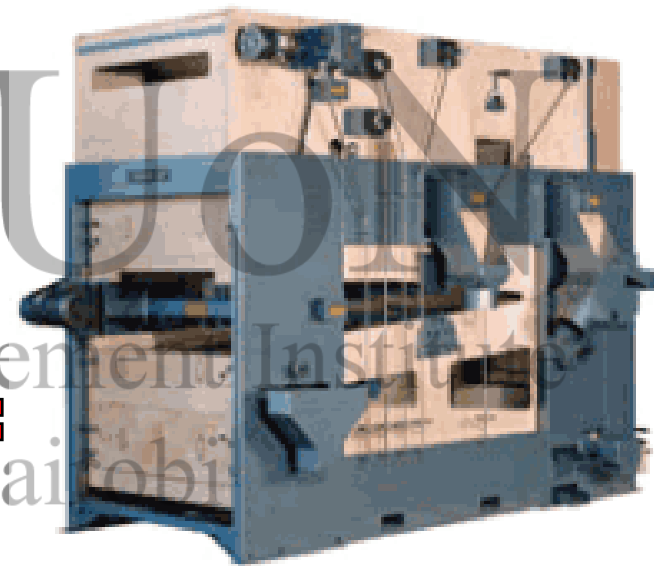
Screen #1 Scalping

Screen #2 Sifting

Screen #3 Sifting

Screen #4 Sifting

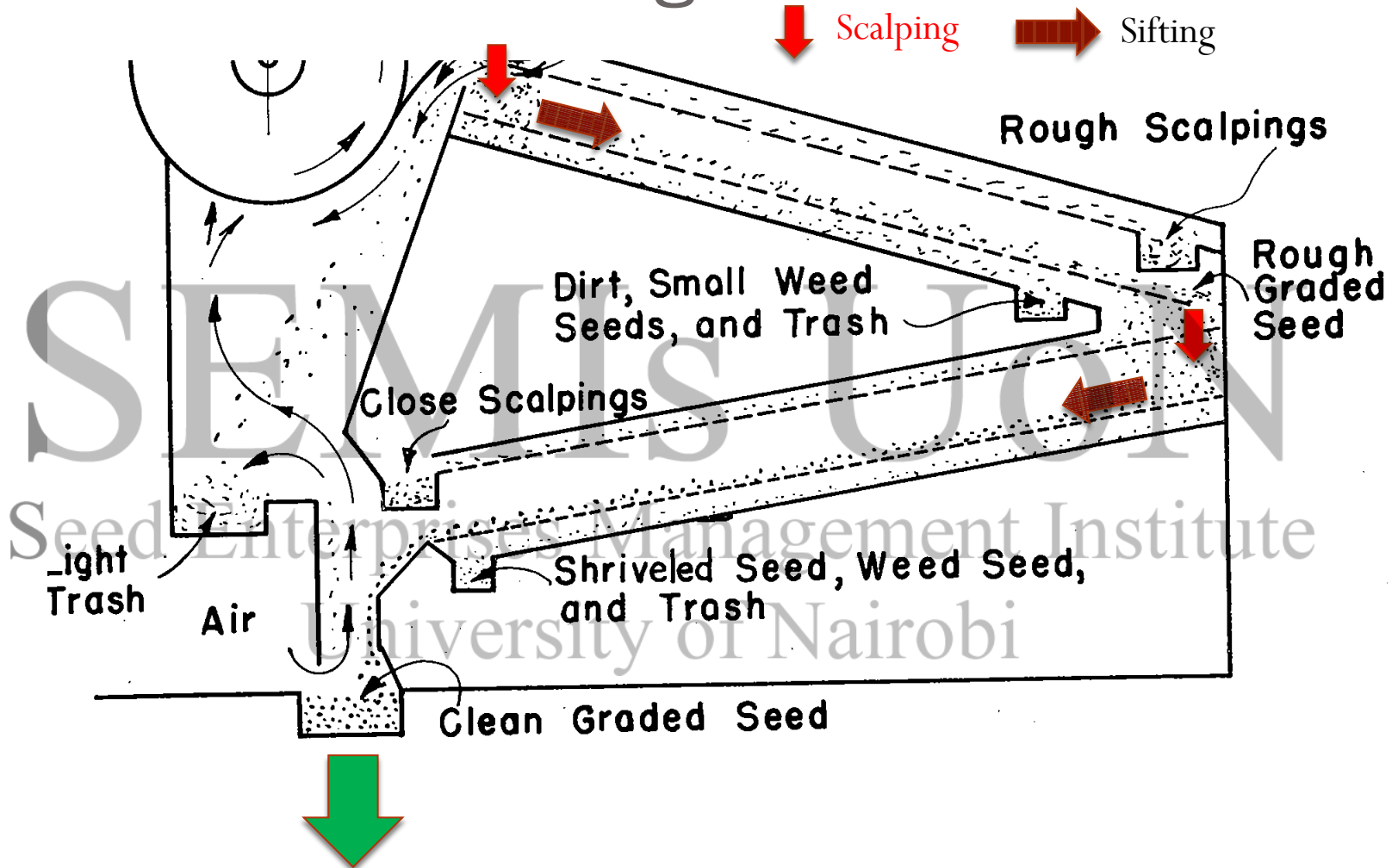
Screen #5 Sifting



A 5T/H 2-Air, 5-Screen  
Air-Screen Cleaner

Modern Air-Screen Cleaner

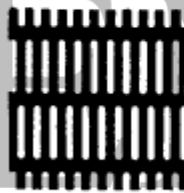
# Air-Screen Cleaning – Clean seed flow



# Air-Screen Cleaning – Screen Selection

- Shape:

OBLONG HOLES

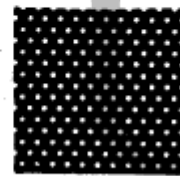


$3/64 \times 5/16$



$8 \times 3/4$

ROUND HOLES



$1/25$

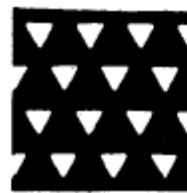


$10/64$

TRIANGLE HOLES



$9/64$  or  $5\frac{1}{2} V$

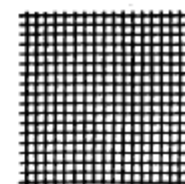


$11/64$  or  $6\frac{1}{2} V$

WIRE MESH



$3 \times 14$



$18 \times 18$

# Air-Screen Cleaning – Screen Selection

- Size:

PERFORATED METAL SHEET										WIRE CLOTH			
ROUND HOLES			OBLONG HOLES		TRI-ANGLES	OBLONG CROSS SLOT	ROUND HOLE HALF SIZES	OBLONG HALF SIZES	SQUARE OPENINGS	OBLONG OPENINGS			
Fractions	64ths		Fractions	64ths	64ths	Finished Screens Made Only in "W" and "B" Model Widths. Sheet Sizes 26" x 61 1/2" and 36" x 88 1/2"			3x3	2x8	4x8 1/2	6x14	
1/25	5 1/2	24	1/24x 1/4	5x 3/4	5	6x 3/4	6 1/2	8 1/2 x 3/4	4x4	2x9	4x15	6x15	
1/24	6	25	1/22x 1/4	5 1/2 x 3/4	8	7x 3/4	7 1/2	9 1/2 x 3/4	5x5	2x10	4x16	6x16	
1/23	7	26	1/22x 1/4 Diag.	6x 3/4	9	8x 3/4	8 1/2	10 1/2 x 3/4	7x7	2x11	4x18	6x18	
1/22	8	27	3/64x5/16	6 1/2 x 3/4	10	9x 3/4	9 1/2	11 1/2 x 3/4	8x8	2x12	4x19	6x19	
1/21	9	28	1/20x 1/4	7x 3/4	11	10x 3/4	10 1/2	12 1/2 x 3/4	9x9	3x14	4x20	6x20	
1/20	10	29	1/18x 1/4	8x 3/4-D		11x 3/4	11 1/2	13 1/2 x 3/4	10x10	3x16	4x22	6x21	
1/19	11	30	1/18x 3/4	9x 3/4		12x 3/4	12 1/2	14 1/2 x 3/4	14x14	3x16 SP.	4x24	6x22	
1/18	12	31	1/16x 1/4-A	10x 3/4-E		13x 3/4	13 1/2		15x15	3x18	4x24 SP.	6x23	
1/17	13	32	1/16x 3/4	11x 3/4-F		14x 3/4	14 1/2		16x16	3x20	4x26	6x24	
1/16	14	34	1/15x 1/4	12x 3/4-G		15x 3/4	15 1/2		17x17	3x21	4x28	6x25	
1/15	15	36	1/14x 1/4-B	13x 3/4-H		16x 3/4	16 1/2		18x18	4x30	4x30	6x26	
1/14	16	38	1/14x 1/2	14x 3/4-I		18x 3/4	17 1/2		22x22	4x32	4x32	6x28	
1/13	17	40	1/13x 1/4	15x 3/4-J		10 1/2 x 3/4	18 1/2		24x24	4x34	4x34	6x30	
1/12	18	42	1/12x 1/4-C	16x 3/4-K		11 1/2 x 3/4	19 1/2		26x26	4x36	4x36	6x32	
	19	44		17x 3/4		12 1/2 x 3/4	20 1/2		28x28			6x34	
	20	48		18x 3/4			21 1/2		30x30			6x36	
	21	56		19x 3/4			22 1/2		32x32			6x38	
	22	64		20x 3/4					34x34			6x40	
	23	72		21x 3/4					36x36			6x42	
		80		22x 3/4					38x38			6x44	
				24x 3/4-L					40x40			6x50	
									45x45			6x60	
									50x50			18x20	
									60x60			20x22	



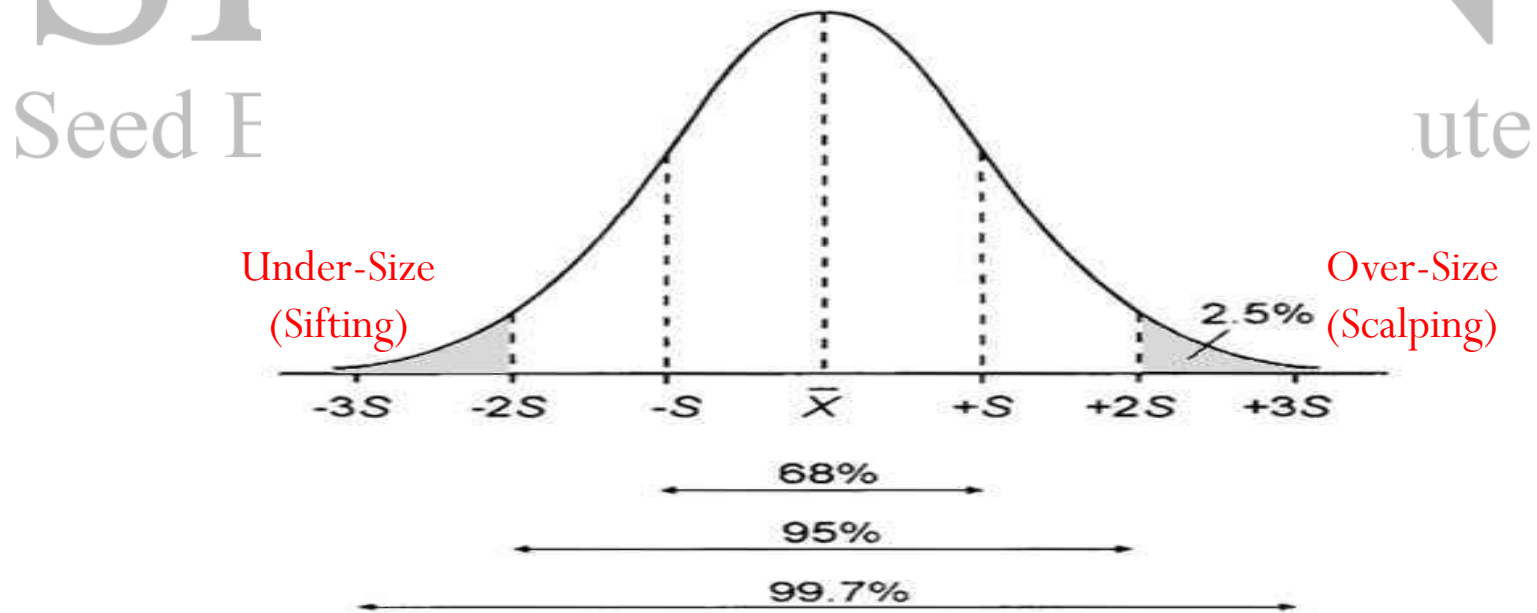
# Air-Screen Cleaning – Screen Selection

- Screen must be selected according to the shape of the crop seed being cleaned -
  - Round seeds: A round-hole top screen and a slotted bottom screen are generally used to clean round-shaped seeds. The round-hole top screen prevents straw, trash, pods and other large and long material (*bolts/nuts, tools*) from dropping through while the slotted bottom screen drops broken seeds and weed seeds thinner than the round crop seeds.
  - Oblong seeds: An oblong top screen and an oblong bottom screen are generally used to clean long seeds. (how?)
  - Lens-shaped seeds: An oblong top screen and a round-hole bottom screen are generally used to clean lens-shaped seeds.



# Air-Screen Cleaning – Screen Selection

- Screen size must be selected according to the result from hand-screen analysis. The bottom line is that to remove most of undesirable material without losing too much good seeds
- The shape of hand-screen should match the screen on the machine
- How much to cut??



# Air-Screen Cleaning - Adjustments

- Rate of feed: Although the feed gate on a feed hopper is adjustable for large changes of rate of feed, the basic adjustment is made by increasing or decreasing the speed of the feed roll
- Screen knockers and tappers: An adjustable knocker or tappers that slightly tap the screens which vibrates screens so that seeds will pass through close and small openings, and will jar loose long weed seeds that wedge so tightly in the perforations that the brushes can't remove them
- Upper and lower air suction: The suction is regulated by an adjustable damper in the air passage
- Variable screen shake: This permit the operator to adjust the screen vibration speed from slow to very rapid
- Screen pitch: Common range in pitch adjustment is from 4 to 20 degrees

# Air-Screen Cleaning - Installation

- It should be installed properly on and securely fastened to a firm foundation.
- Proper air ducting from the cleaner is extremely important. Sharp turns, improper junctions, poor connections and poor collectors all contribute to poor air separations in a cleaner. Improper air exhaust also causes a very dirty, dusty plant
- A good system to manage good seeds and different discards – both air-lifting and screening products.
- Operator safety and friendly environment!
- Computerized Air-Screen Cleaner (Dr. Shyy's US patent)....

Dr. Shyy's US Patent on Automation of Air-Screen Cleaner - 1991

United States Patent [19]

Misra et al.

[11] Patent Number: 4,991,721

[45] Date of Patent: Feb. 12, 1991

[54] AUTOMATION OF AN AIR-SCREEN SEED CLEANER

[75] Inventors: Manjiv K. Misra; Yuh-Yuan Shyy, both of Ames, Iowa

[73] Assignee: Iowa State University Research Foundation, Inc., Ames, Iowa

[21] Appl. No.: 231,946

[22] Filed: Aug. 15, 1988

[51] Int. Cl. B07B 9/00; B07B 4/02; G05B 13/02

[52] U.S. Cl. 209/33; 209/37; 209/139.001; 209/157; 209/546; 209/557; 364/502; 364/552

[58] Field of Search 209/21, 30-37, 209/44.1, 44.2, 134-139.1, 146, 147, 149, 153, 194, 237, 238, 255, 257, 546, 549, 552, 555, 557, 629, 639; 35/215, 218, 270, 279, 413, 423-426; 364/500, 502, 552, 555, 406/28, 168, 169, 373

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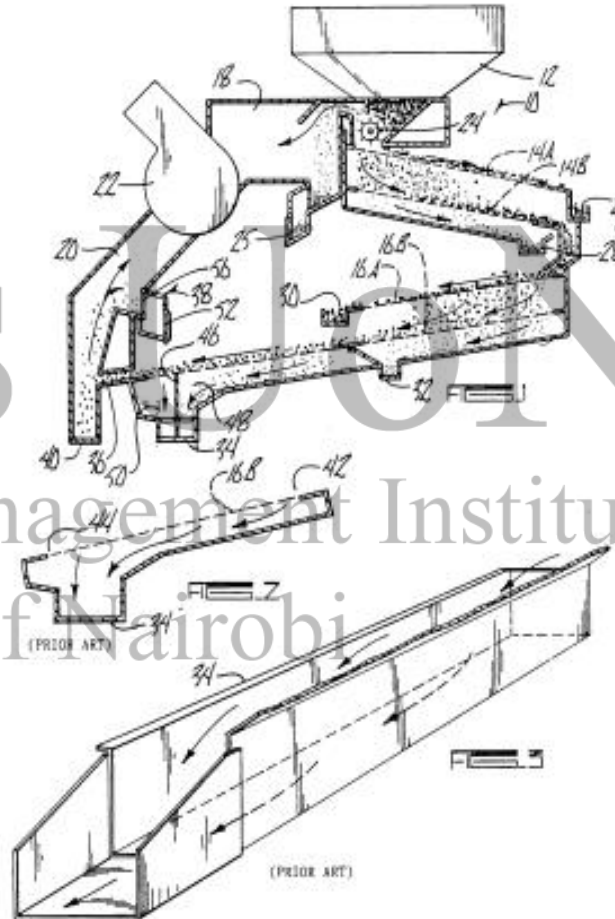
"Profitability Through Computerized Conditioning", Misra et al., Eighth Annual Seed Technology Conference, Feb. 25-26, 1986.

Primary Examiner—Margaret A. Foccarino  
Assistant Examiner—Edward M. Wacyra  
Attorney, Agent or Firm—Zarley, McKee, Thorne, Voornhes & Scafe

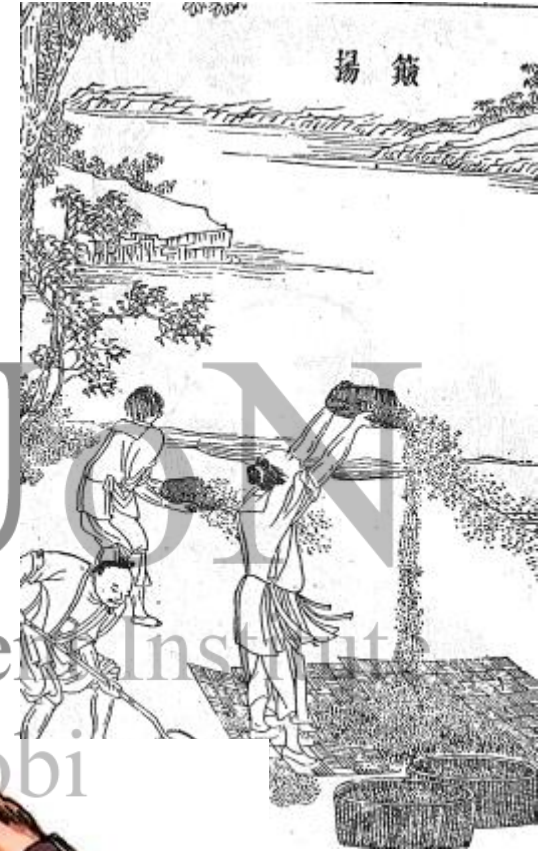
ABSTRACT

A cleaning system is provided for separating desired material from undesirable material in a mixture of particulate materials. The system includes an inlet for receiving the mixture of materials and an outlet for discharging the desired materials. At least one screen is provided for separating undersized material from oversized material within the mixture, and at least one vacuum air-lift is provided for separating the lighter material from the heavier material within the mixture. A first sensor is mounted below the discharge end of the screen for sensing the quantity of undersized material separated by the screen and a second sensor is mounted in the air-lift for sensing the quantity of lighter materials separated by the air-lift. The signals generated by the sensors can be received by a processing unit which adjusts the amount of separation by the screen and by the air-lift to achieve the desired efficiency of the cleaning system.

16 Claims, 23 Drawing Sheets



# Air-Screen Cleaning



Questions?

