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DESIGN OF AUTOMATION OF SPECIFIC GRAVITY SEED GRADATION PROCESS.

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Abstract: *Millions of tons of seed are processed in India every year for qualitative and quantitative improvements. Quality seed alone can enhance 15 to 20 percent of productivity .It is estimated that quality seed under optimum management may contribute to the tune of 45% of total crop production. Looking towards need to achieve higher efficiency in seed gradation, improved quality output and high degree of reliability in performance the author designed state of art automation for sp. gravity seed gradation machine. The achievements observed due to implemented improved method are higher efficiency, improved quality and high degree of reliability. This paper discusses about the design of automation in sp. gravity seed grader, achieved by applying various sophisticated mechanical and electronic systems.*

Keywords: *Automation, Seed, Gradation Process*

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INTRODUCTION

Presently manually controlled specific Gravity seed gradation machines are used in India for gradation of seeds and grains of various types on the basis of their specific weight. Manually controlled gravity machines has its own problem and limitations such as improper setting of parameter, excessive setting time, more grading cost and dependency on operator. Worldwide millions of tons of grains and seeds are processed every year for quantitative and quantitative improvement. Grains are graded to provide good quality food grain for daily consumption, while seeds are graded to provide good quality seed to the farmers for sowing in the field. Good quality seeds have high percentage of germination. Value addition depends on quality of gradation. Quality seed is the basic requirement for sustainable agriculture.

Post-harvest management has a great importance in seed industry. At present Indian seed processing industry is based on traditional, time consuming and laborious process. This is a seasonal and time bound activity to fulfill the market demand. The term specific gravity seed gradation machine refers to the machine used for gradation of seeds or grains on the principle of weight difference (sp. gravity) of seeds. Traditional manually controlled specific gravity seed gradation machines have its own problem and limitations, such as improper setting, more setting time, bottle necking, seed damage and amongst all less productivity. Existing specific Gravity seed gradation machines has a manual setting facility for the change in every type & size of seed. Thus quality of gradation is completely depended on skill of operator and every chance of mismanagement led to deterioration of quality as well as reduction in quantity of processed seed.

Worldwide seed and grain processing industry is multi-billion dollar business where billion tons of seeds/ grains have been processed every year. Grains are graded to provide good quality food grain for daily consumption, while seeds are graded to provide good quality seed to the farmers for sowing in the field. Quality seeds fetches 25 to 40 percent more price in market as it gives more yield because of higher germination and vigor due to automatically controlled specific gravity seed gradation machine & also helps to improve brand image in market. Implementation of mechatronics to automate specific gravity seed gradation machine for qualitative and quantitative improvement with reduction in processing cost and time is primary need of seed business. Liberalization of trade policies and internationally competitive market forced Indian seed industries in keeping abreast with technological advances to stay competitive in the global market system. To meet increasing demand and competition Indian seed processing industry are trying to modernize & update grading systems.

To tackle this problem systematically the mechatronic concept was implemented for automation of specific gravity seed gradation machine. The automation helps to maintain consistency in regards of yield & quality with reduction in processing time and cost. The paper also emphasizes redesigning of mechanisms responsible for easy adjustment of various setting parameters.

The use of electromechanical, pneumatic, pneumo-hydraulic and electronic systems are required for auto adjustment and control of process parameters. The use of sensors, transducers and programmable logic controller made it possible to operate the machine from the single operator's desk. The feedback system provided take care of process and safety interlocks to avoid bottlenecking and breakdown in the machineries.

Working Principle of Machine

Specific Gravity seed gradation machine is used for grading of seed or grain on the principal of specific gravity difference in seeds. It separates grains or seeds of similar in size and shape, but having different specific gravity. The grains are fed to the deck through the storage hopper. Deck is the rectangular top with wire mesh surface supported by M.S. Structure and seeds are fed through the storage hopper. The wire mesh surface allow the formation of air cushioning on the deck surface. The bottom side of deck is provided with blowers for generating air in desired quantity and pressure. There is a provision for deck oscillation and adjustment of longitudinal and transverse slope.

MATERIALS AND METHODS

Present conventional method of gravity machine setting consist of manual adjustment of the important four parameters responsible for efficient grading of seeds/grain. These four parameters are

1] Longitudinal slope adjustment of deck.

2] Transverse slope adjustment of deck.

3] Oscillation speed adjustment of deck.

4] Adjustment of damper position of blowers

The desired changes in the mechanism of manually controlled specific Gravity seed gradation machine were made and incorporated pneumatic, electromechanical & pneumo-hydraulic systems for operating various mechanisms for automation of specific Gravity seed gradation machine. This system is easily adoptable for automaton. The provision of sensors and electronic control panel with programmable logic controller made it possible to control all parameters precisely.

Application of Mechatronic concept- The system designed for governing various adjustments for efficient grading is as follows,
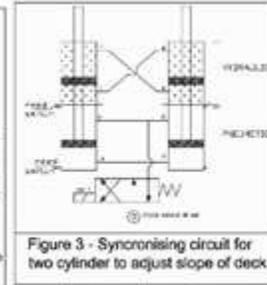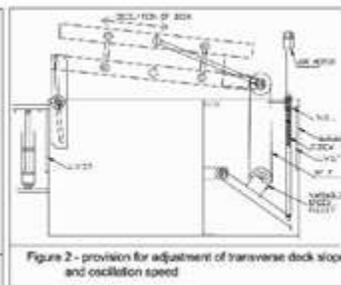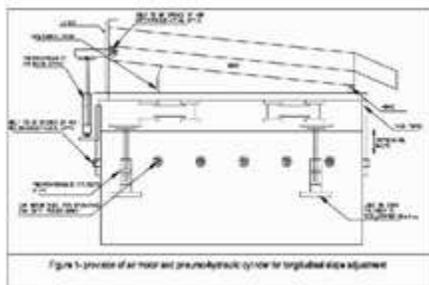
1. System for Longitudinal slope adjustment of deck - The pneumo hydraulic cylinder was given for adjustment of slope refer fig.1. The cylinders of same capacity was provided at both end of deck base swiveling frame which helps to lift the deck. The synchronized pneumatic circuit was designed and provided to ensure motion of both the cylinders uniformly at same speed. (figure 3) This avoids twisting in deck. It is necessary to open locking nut before lifting the frame by rotating air motor provided therein. After achieving desired deck slope the lock nut are to be tighten by reverse rotation of pneumatic motor. (fig..2).The details about lifting force required and torque requirement is depicted in Table. 1.

Table:1 - Torque And Force Requirement for various adjustment

Type of setting			Force required	Torque required
Longitudinal slope		Bolt loosening torque		130N-m
adjustment		Deck lifting force longitudinally	230kg	
Transverse slope		Bolt loosening torque		224N-m
adjustment		Deck lifting in transverse direction	442kg	
Damper position		Torque Required		70N-m
adjustment				
Oscillation speed		Torque Required		70N-m
adjustment				

Table No. 2: Other Benefits of Auto sp. Gravity:

Particular	Manually control m/c	Automatic machine	Benefits
Production Increase	12.0 Ton/shift	13.5 Ton/shift	1.5 Ton / shift
Valve addition	Say Rs. X/- per ton	Rs.(1.25 to 1.4)* X per ton	25%-40% value addition.
Export market to final produce	Limited potential for export	Potential of export market due to uniform quality	Good export potential
Export market to Gravity machine	No export market	Its unique feature generates export market for gravity	Good export potential to auto gravity machine itself.
Labour requirement	Skilled operator needed	Skill do not require for setting.	Auto setting facility.

Figure 1- provision of air motor and pneumohydraulic cylinder for longitudinal slope adjustment

Figure 2 - provision for adjustment of transverse deck slope and oscillation speed

Figure 3 - Syncronising circuit for two cylinder to adjust slope of deck

2. System for Transverse slope adjustment of deck:- The higher capacity cylinder and air motor was provided to sustain the increased load, however the working mechanism is same as above The details of lifting force required and torque requirement is presented in Table. 1 & working is shown in fig.2.

3. Adjustment of blower damper: The blower damper adjustment was done by separate air motors provided for each damper. The air motor torque required to operate damper is given in Table-1. Detail working is shown in figure no.4 & 5.

Figure 4 - Adjustment of blower air damper

Figure 5- Air flow in deck

4. System for Adjustment of deck Oscillation speed: Provision of variable speed pulley was given for online adjustment of speed of oscillation. The speed of oscillation can be adjusted while the machine is in operating state also. The speed pulley is mounted on oscillating frame move up or down with the help of screw rod. (figure no.4)The clockwise/anticlockwise rotation of screw changes speed of oscillation. (figure no.4)

Fig.6. Flow Pattern Of Seeds

Control panel: Two modes are provided for operation i.e.

a) Auto Mode b) Semi Auto

Auto Mode- The setting data for adjusting various parameters is stored in the data memory of programmable logic controller for various types & varieties of grains / seeds. Operator has to select type of seed from chart and press button "Enter" of the P.C. Automatically all the setting slope of deck in longitudinal & transverse direction, speed of oscillation and adjustment of air dampers for different blowers. If operator needs some marginal changes in setting these is a provision of button: 'SET' is given on control panel Operator has to press button 'SET' then change the slopes, speed of oscillation, blower damper setting by the push buttons provided on

panel. Once he gets satisfied results he will again press button 'SET'. The latest setting will now be stored in the data for that particular grain and old will go in history sheet provided in P.C. Position Sensors are provided for getting exact feed back of deck slope position , air damper position . Transducer is used to get exact feed back speed of oscillation of deck. Safety interlocks are incorporated in the program to ensure safer operation. Even in semi auto mode these interlocks are operational.

Semi auto mode- In this mode operator can control operations from operator's console by changing detent type knob from auto to semi auto mode. The push buttons are provided for performing various operations. Worldwide the specific gravity seed gradation machine with grading capacity 2 Ton/hrs (2TPH) is popularly used. Hence 2 ton /hr capacity model is taken for performing work.

RESULT AND DISCUSSION

The comparative data of manually operated & automatically controlled specific Gravity seed gradation machine presented in chart no.1 and 2 revealed that the power cost saving is 39%, labor cost reduced up to 20%, saving in setting cost of machine is 100% by auto controlled specific gravity seed gradation machine. The total reduction in processing cost due to automation was up to 56.52% reduction over manually operated specific gravity seed gradation machine.

Refer chart no.3 and 4, it is estimated that by considering 8 months season of seed processing total 8000-8400 tons seed/grain could be processed by automation of specific Gravity seed gradation machine which is reflected to be 13 to 15% higher than manually controlled machine resulting in the saving of Rs.3 lakh to 4 lakh per season per machine. Automation of specific gravity seed gradation machine (table no.2) it was found to be 25% to 40 % value addition due to quality output from machinery. The automation of specific gravity seed gradation machine mainly consist of auto adjustment of deck slope, oscillation speed and air flow by using electro mechanical, pneumatic, pneumo hydraulic and electronic systems to control activity from operators control desk. As per table no.1, the force required for longitudinal slope adjustment & Transverse slope adjustment due to automation is 230 & 442 kg and torque required for loosening of bolts for slope adjustment are 130Nm. &224Nm, respectively. For blower damper & oscillation speed adjustments required torque are 70Nm each .In manually operated machine the adjustment of slope & speed of machine is totally dependable on the skill & energy of operator however, due to seed type & specific gravity wise control data fed to the controller of

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auto machine controller, the exact adjustments increased quality & quantity output of specific gravity seed gradation machine.

CONCLUSION

Country like India having agro based economy is concentrating on improving quality of agro produce. Value addition in agro produce is the key area, where the government of India is focusing Export of Agro produce can generate revenue. Automatic specific gravity seed gradation machine not only gives quality output at less processing cost but also the other benefits like export grade output, increase production rate, value addition in agro produce etc. Compared to these advantages the cost incurred in automation of machine i.e. Rs.4.00 lakh to Rs.6 lakh is negligible and can be recovered only in one season by saving in processing cost. Good quality seed will increase yield of farmers in the field. Value addition in agro produce can only help farmers to increase their economical standard. It is the need of the time to penetrate the advantages of technology to the biggest farmer community. There is a wide scope to work in this field. Engineers and Technocrats should come forward to develop new machines and processes which will help formers to relive from their stressful work and help in increasing the value of their produce.

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