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Research Article

Automatic temperature control of flute in paper corrugated box manufacturing machine

Dr Bharat Chede [a], Ayu Kalidas Ramteke[b], Swapnil Choudhary[c], Nitin Sawarkar[d]

[a b] Professor Mechanical Engineering, Wainganga College of Engineering and Management, Nagpur
Research Scholar (M.Tech CAD/CAM), Wainganga College of Engineering and Management, Nagpur
[c , d] Assistant Professor Mechanical Engineering, Wainganga College of Engineering and Management, Nagpur
[a]drbharatchede@gmail.com,[b] aayramteke34@gmail.com, [c]smchoudhari001@gmail.com, [d]nitinsawarkar304@gmail.com

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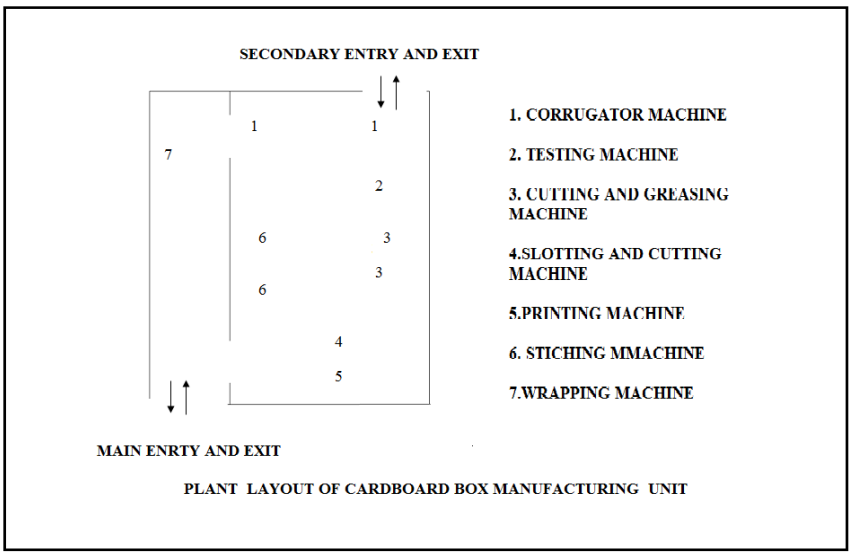
Abstract: Paper corrugate boxes are widely and extensively used for packing of industrial and domestic item. There are various kinds, depending on the item to be package, size, thickness, and strengths. Cardboard pass through flutes at high temperature at 180-250 degree Celsius. Due to continue running of roller, roller temperature increase above 270 degrees Celsius and leads to halt production for some time to cool down rollers. In this paper, studying feasible option to overcome overheating problem..

Keywords: Paper corrugate box, roller temperature, production halts.

1. Introduction

Cardboard manufacturing follows simple manufacturing process and most of processes perform on corrugator machine. Corrugator machine is combination of small machine which performs couple of operation together on raw materials. One of operation, where raw material passes through series of roller which are at high temperature and temperature continuously increase on par critical point where raw material can be damaged.

2. Packing Industry Machine

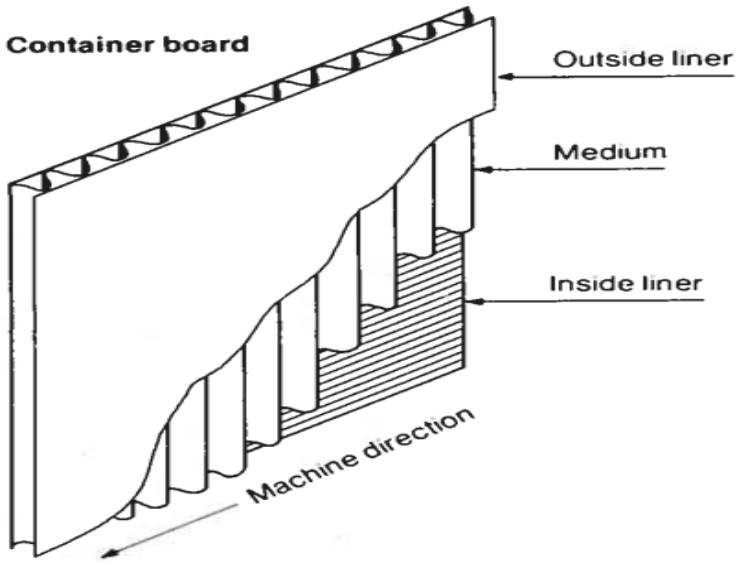


PLANT LAYOUT OF CARDBOARD BOX MANUFACTURING UNIT

1.Corrugator Machine

Fig.1. Corrugator Machine

Corrugator machine is combination of couple of machine to perform two-ply paper from. The operation basically divided into four sub-operations: 1 unwinding and conditioning two webs, 2 actual corrugating of medium, 3 combining and gluing two webs, 4 holding a single face in bridge to allow the glue set dry.[1][9][10]



Corrugated board flute sizes (Source: Lowe 1975, p.100)

Fig.2. Layer in cardboard

Flute	Number of flutes[1] per		Flute height[2]	
	Lineal foot	Lineal meter	inch	mm
A	36	118	3/16	4.76
B	51	168	3/32	2.38
C	39-42	128-138	9/64	3.57
E	96	316	3/64	1.19

Fig.3. Table for size of flute

The wave pattern in medium is due number of flute appear on roller. As above table, number of flute are given and we start moving from A onward wave pattern started getting compressed. The dimension of the box is given by clients and

It can be change as per requirement.

2. Testing Machine

Testing machine basically add one layer of paper onother side to make three-ply cardboard. As shown in the below figure, two-ply material passes through testing machine three-ply material

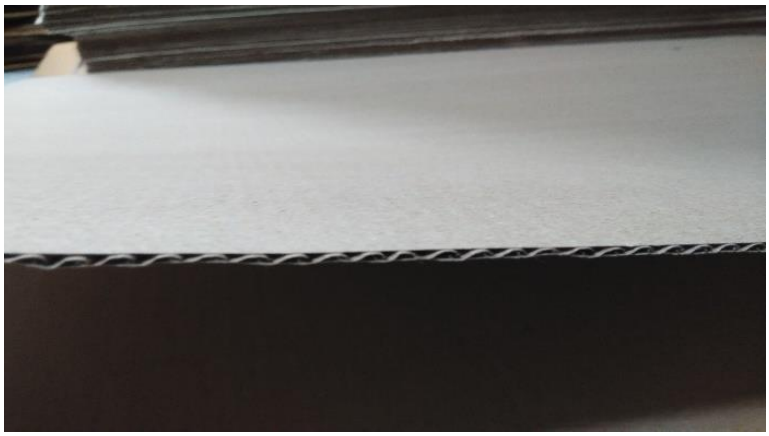


Fig.4. Three-ply machined material

Testing machine consist of roller which are adjust as per requirement. The pressure can be changed by using appropriate gear configuration.

Fig.5. Testing Machine

Testing machine use glue in extreme low amount to stick paper on other side without making cardboard moist.

3. Creasing and Cutting Machine

After material pass through testing machine, it consists of unevenness at the edges which can create problem while joining them. To avoid this, material pass through greasing and cutting machine which make even edge cut material at the required dimension. This machine performs simultaneous operations of cutting and applying pressure cardboard at required dimension. There are two cutter on the roller, one is sharp for cutting purpose and other is blunt which produced lining on the board for making folding and obtaining its required shape.

Fig.6. Creasing and Cutting Machine

4. Slotting and Cutting Machine

Fig.7. Slotting and Cutting Machine

The slotting and cutting machine is used for cutting machine and creating interlock hooks so cardboard can withstand when force applied on it.

5. Printing Machine

Printing machine consist on big roller of 70cm -80cm of diameter and dies are fixed on it and start rotating at medium speed 30-40 rpm creating impression on the cardboard.

Fig.8. Printing Machine

Printing machine only produce monotone colour logo on the cardboard at each side.

6. Stitching Machine

The stitching machine use G.I. iron strip to join two end of cardboard and giving it it's final form as box.

Fig.9. Stitching Machine

7. Wrapping Machine

It is machine wrapping machine which wrap plastic around cardboard for avoiding getting moist or something.

3. Identification of Problem in Corrugator Machine

Fig.10. Corrugator machine flutes (side view)

The corrugator machine consistsof fourrollers with diameter of 20 cm diameter and three of them connected with electric heater 3-phase and 415 volts with 50 Hz. Each of three roller have 9 heaters and every single rod produce 7 kw and one roller produces 63 kw and there three, so they will produce total heat of 190 kw [12]. These rollers are driven by electric motor of rpm 1440 by chain mechanism. Overall rpm of these four roller are 25-30 rpm. With 190 kw of heat produce very high heat which increase temperature up to 270 degrees Celsius. Working condition required temperature is between 180-250 degree Celsius above or below this range can harm raw material. Raw material passes through series of rollers from roller which use cohesive mixture of corn to act as

glue agent and next between two flutes (roller has grooves over them), these rollers have heater connected to them in order to remove excessive moist remain in raw material due cohesive mixture.

The range temperature between 180 to 250 degree Celsius which is ideal for making two-ply [11]. Due to continuous supply of heat roller temperature continues to increase and reaches to critical temperature of 270 degrees Celsius which is harmful for raw material which burn material and if temperature below 180 degrees Celsius which can cause for improper sticking of material which will consider as fail material. The continuous rise in temperature leads to stop production, until it reaches below 200 degrees Celsius. Due to such halting, it affects production efficiency and directly increase idle time and that leads successive machine to stop working unless they have buffer storage raw material for continuation of respective machines.

Roller Specifications

Diameter = 20 cm

Length =120 cm(approximate)

Material = Iron

Heater material= Brass/chrome

Heater capacity= 7 kw

Roller rpm = 25-30 (it may vary)

Temperature range = 180-250 degree Celsius

For continuous working of machine, we have to control the voltage amount which provide to heater and maintaining the temperature between 180-250 degree Celsius. To maintain temperature range, there are some of the feasible solution are follow as-

1.Rheostat with potentiometer

The aim of a voltage regulator is to maintain a generator's output voltage at a desired value. The voltage would also begin to change as the load on an AC generator increases. The explanations for this voltage change are the change in the internal voltage drop across the winding of the armature caused by a change in load current and the changes in power factor [5][6][7].

The electrical symbol used for a voltage regulator is shown here. An electronic device connected to the output of a power supply to maintain the output voltage at its constant rated value is a voltage regulator. Normally, done by voltage regulator circuit.

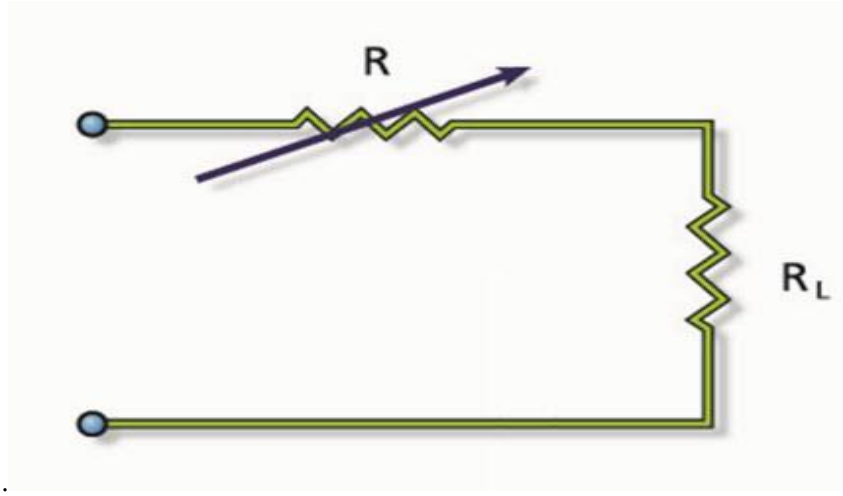


Fig.11. Rheostat construction

The easiest method of using a variable resistor is a rheostat. In light dimmers and audio control knobs, rheostats can be commonly seen. It uses two terminals: one connected to the end of the track, the other connected to the mobile wiper. Turning the spindle alters the resistance from zero to full resistance between the two terminals. For example, rheostats may be used to regulate the speed of a motor or the rate at which a capacitor charges. Rheostats are also used to adjust the current[4].

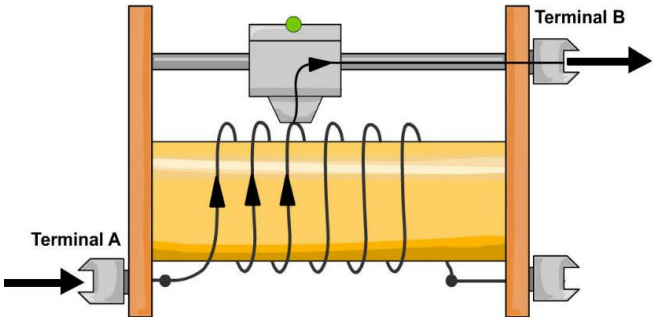


Fig.13. Rheostat

2.Resitive Temperature Detector

The resistance temperature detector, or RTD, is another form of electrical resistance temperature sensor.RTD's are precision temperature sensors that are made from high purity metals such as platinum, copper or nickel woundinto a coil and whose electrical resistance, close to that of the thermistor, varies as a function of temperature. RTD's for thin-film are also available.Such devices deposit a thin film of platinum paste on a white ceramic substrate [13][14].

Resistive temperature detector, or RTD, is another form of electrical resistance temperature sensor. RTD's are precision temperature sensor that are made from high purity metals such as platinum, copper or nickel wound into a coil and whose electrical resistance, close to that of the thermistor, varies as function of temperature. RTD's for thin-film are also available. Such device deposit a thin film of platinum paste on a white ceramics substrate.

Resistive temperature detector has positive temperature coefficient(PTC), but their performance is highly linear in relation to the thermistor, providing very precise temperature measurements. They do, however, have very low thermal sensitivity, which is that a change in temperature, for example only causes a very small change in performance, l ohm per degree Celsius. The most popular forms of RTD's are made of platinum are referred to as Platinum Resistance Thermometer or PRT's with the Pt 100 sensor, which has a standard resistance value of 100 at 0 degree Celsius, the most widely available of them. The downside is that Platinum is costly and its price is one of the key drawback of this kind of system

Fig.14. Resistive thermistor

4. Conclusion

There are many possible solution ranging from small amount to huge that may cost fortunes. Rheostat is simple and easy solution which control voltage as per requirement for maintaining corrugator machine's flute temperature.

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