International Journal of Food, Agriculture and Veterinary Sciences ISSN: 2277-209X (Online)
An Online International Journal Available at http://www.cibtech.org/jfav.htm
2012 Vol. 2 (3) September-December, pp.37-43/Preethi et al.
Research Article

STRATEGIES FOR REDUCTION OF REWORK IN A CONFECTIONERY UNIT

[*]R.Preethi[1] S.K. Mathanghi[2,] K.Sudha[3] and D.Thyagarajan[4]
[1& 2]Food processing technology, College of Food and Dairy Technology, TANUVAS, Chn-52
[3& 4]College of Food and Dairy Technology, Koduvalli, Chennai-52
**Author for Correspondence*

ABSTRACT
Confectionery may require reclamation or reworking for a number of reasons; when high speed production lines stop because of a problem downstream, such as a fault in coating machines or a breakdown in the packing line. Equally, sweets may be rejected as being mis-shapen. Ingredients produced on a continuous basis were often diverted into scrap bins until the line was running again, as stopping production may be difficult and costly. The reclamation of confectionery waste can be difficult, which in the past has resulted in product simply being scrapped. However, the high cost of raw materials such as sugar and cocoa means that it was increasingly important to try to reclaim and rework "off-spec" product. To prevent and reduce this rework process in one product preparation in a centre filled candy confectionery unit certain cost effective conventional strategies like prevention of leakers, dustiness, striping and cracking were applied and the rework time were reduced greatly by fifty percentage.

Key Words: *Confectionery, Rework Reduction and Strategies*

INTRODUCTION

At one time or another, each chocolate and confectionery manufacturing company represented has experienced production problems resulting in a product that was not acceptable for sale or further processing. Hopefully, such a product can be diverted from regular processing, and were transferred to a previous production point and reintroduced into the system *(Flapper et al., 2002)*. The goal wasto reprocess into a quality product that can be offered for sale. The whole process is called rework process. Rework is an unincorporated food product kept for subsequent use or reprocessing.

MATERIALS AND METHODS

For the preparation of centre filled candy the raw material received from the supplier, after finishing the quality checking the raw material was stored in the warehouse with the status slip. Received raw material was then weighed as per the requirement. Then the sugar syrup was prepared separately in the sugar syrup tank which was made up of food grade stainless steel, 166 liters of cold water was added with 443.9 kg of sugar and indirectly heated with steam, and the temperature of the mixture was maintained at 60 – 65^{o}c. The mixture was prepared with continuous agitation for 30 mins, with the º brix value of 73-74 ° bx. The prepared sugar syrup was pumped to the sugar and Liquid glucose (LG) tank, in that three barrels (900Kg) of Liquid glucose was added and heated at the temperature of 70-75^{o}c and the brix value of the sugar and LG syrup was78-79º bx. After that the syrup was pumped to the storage tank. Cold water was heated at 60-65^{o}c in the separate tank and pumped to the premix tank. With the hot water the ingredients like Glycerol Mono Sterate (GMS), MSK, vanaspathi, lecithin and salt were added and mixed well for half an hour. The well mixed premix blend was pumped to the storage tank through the Operational Pre Requisition Programmer (OPRP) where the removal of metallic and foreign materials takes place. Automated discharge tank unit was used to release the stored sugar and Liquid Glucose (LG) syrup and premix blend was automatically weighed and poured into a cooker.

Finally the received mixture was cooked at 121± 1^{o}c, for 30 mins. During cooking the 10 % (5-13Kg) of rework materials were added. After cooking the mixture was called as mass, after attaining 121^{0}c the steam was cut-off and 16.2 gm of flavoring agent called Ethyl Vanillin was added. Once cooking was done the mass was poured into the cooling table; there the temperature of the mass goes down to 30 –

35°c. And the mass was in semi harder condition. The cooing of the mass was carried out using humidifier (using chlorinated water). Centre mixer was filled and then the semi harden mass was then loaded in the batch roller. It comprises of center hopper, center hosepipe, rope seizer wheel, and Uniplex (it consist of a dye and dye cutter). The formed candies were passed through the conveyor.

During the conveyor pass through candy was made harden by lowering the temperature and at sustaining the humidity level to 20 ± 2°C and of 40-60 % respectively. During conveying the excess choco chips that were cut unevenly were collected in the trays and reused. The well formed candies were passed through the metal detector to sort out the candies that have metal pieces of 1.5 – 2mm size.

The presence of defective candies were ascertained and disposed off. The naked sweets (candy without wrapper) was collected in the clean trays and wrapped by means of double twist wrapping machine. The wrapped candies were assembled in crates and passed to the secondary packing. There the wrapped candies were weighed and filled in the pouches and then the pouches were filled in the master cartons. The packed candy was then stored in the store and finally dispatched. The complete process flow chart of preparation of centre filled candy was shown in the Figure 1

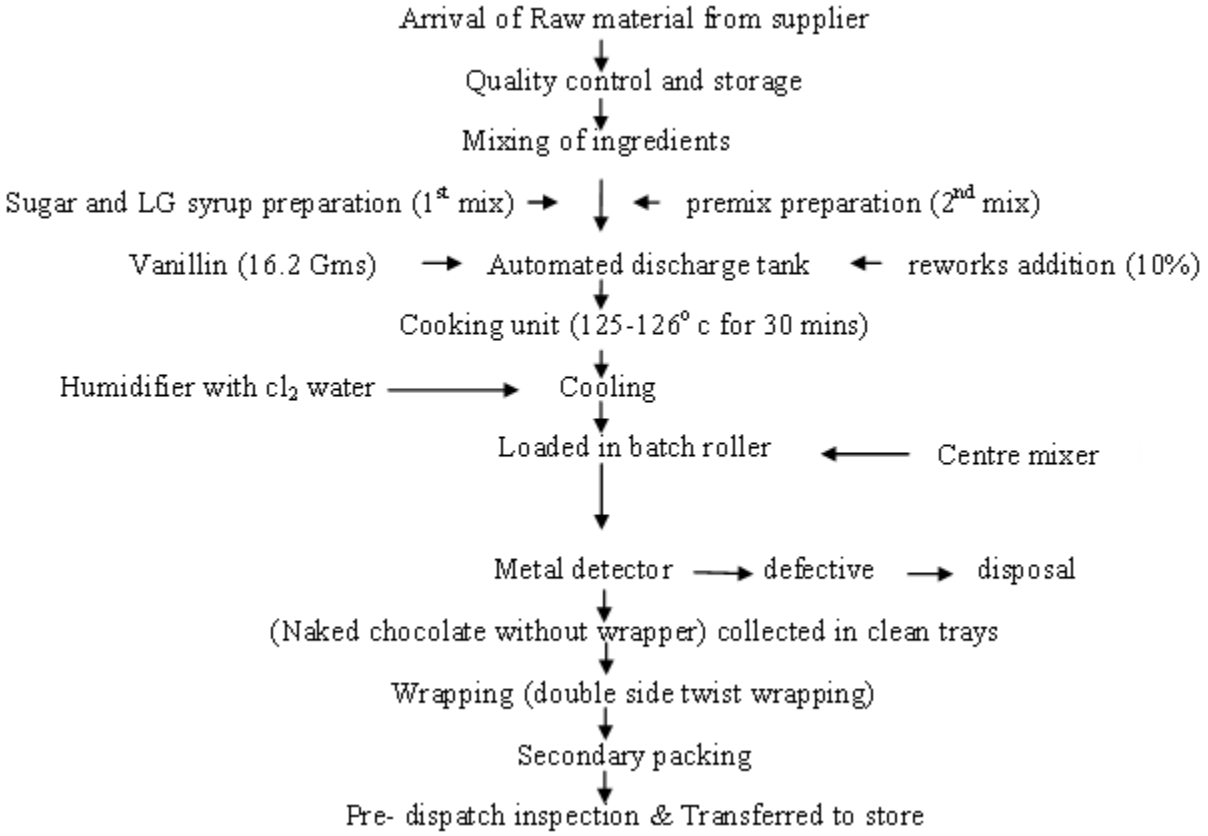

Figure 1: Process Flow Chart for Preparation of Centre Filled Candy

RESULTS

The reworking process varies considerably according to the type and form of material being handled. This can vary from raw materials and ingredient blends to "finished" products *(Goyal and Giri 2001)*. Individual gums and boiled sweets can be added to hot water and agitated until they gradually dissolve to result in a uniform mixture. Agglomerated masses or large solids would first require grinding or chipping to smaller pieces before being processed in a similar manner. Hard, friable solids and insoluble ingredients may need milling or grinding to a manageable particle size. Often a closed vessel was

required, as the operating temperature required to melt or dissolve the solids can lead to loss of volatile ingredients, particularly flavorings, through evaporation. Centre filled candy confectionery has additional requirements. If even small amounts of water were introduced into molten Centre filled candy it can "set" immediately also tends to work harden. Temperature must be carefully controlled to prevent burning or caramelization of the product. The critical areas where there were possibilities of reworks and the reason of reworks were identified. The critical areas were cooker; cooling table, batch roller, primary and secondary wrapping machines. The reasons for reworks were sticky mass, center bursting, without center, less weight and improper shape.

Table 1: possible critical areas of rework

S.No	Critical areas	Possible reasons for reworks
1.	Cooker	Colour deviated mass, temperature deviation
2.	Cooling table	Over harden mass, falling in the floor
3.	Batch roller	Centre bust, candy without centre, sticky mass, less weight candies
4.	Cut and primary wrap machine	Broken candy, mass that stick to the rolling wheels, hardened mass, brokens due to improper cut
5.	Secondary Wrapping machine	Mis-shapen candy, shearing of the twisting rubber

Table 2.Time taken for making a batch of product compared with the rework time

Time cost for the final product						Total batch Time (min)	Rework time/ Man power/ batch
No. of manpower /batch	Raw materials addition (min)	Mixing time(min)	Product batch (min)	Packing (min)	Total time (min)		
15±0	26.47 ± 4.46	38.53± 4.12	39.47± 10.65	30±0	129.77± 11.45	37.94± 6.20	4±0

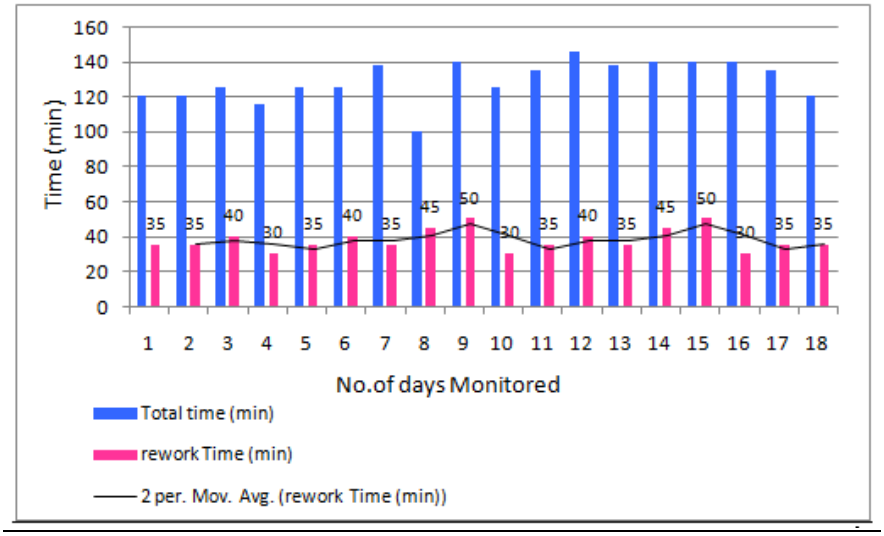

Figure 2: Comparison of time required for final product and rework process

Table 3: Correlation between the temperature and rework parameters

Total mass in cooker (Kg)	Temperature as per Specification ($121^o \pm 2^oC$)	Accepted amount of mass in Kg	Undesirable coloured product in Kg	Correlation b/w temp. & undesirable	correlation b/w temp& accepted
900 ± 0.0 Critical area(cooling table)	123.13 ± 1.73 Cooling temperature as per Std (30-40^{o}C)	894.29 ± 31.07 Accepted amount of mass in Kg	9.82 ± 18.35 Undesirable coloured product in Kg	-0.29457* Correlation b/w temp. & undesirable	-0.6272* correlation b/w temp& accepted
894.29 ± 31.07	34.71 ± 1.84	884.88 ± 37.36	9.41 ± 12.01	-0.12493*	0.02346 ^{NS}

The identified possible rework areas were monitored all the time during the processing of centre filled candy preparation. The time cost factor was elucidated and the appropriate stratagem was used in the critical areas where there were possibilities of reworks can occur.

Data are Mean ± Standard Deviation

The confectionery unit was monitored for a period of 18 days and it the time comparison for regular work and rework is presented in fig1. In order to do the rework activity at least 4 labourers were needed and the labour cost increased by 27 percentage. The cost control was one of the major tasks in any food industry *(Inderfurth et al., 2003)*

Data are Mean ± Standard Deviation

0.05% level of significance

There exist a significant negative correlation between temperature variation and undesirable coloured products in both critical areas of cooker and cooling table. At higher temperature, more sugar can be dissolved in the same amount of water. Once dissolved, however, the sugar will raise the boiling point of water. The result of these physical chemistry properties was a specific relationship between the solution's boiling point and the amount of sugar contained therein. The first part of basic candy making, therefore was cooking a sugar solution to a specific temperature to form a supersaturated solution with known solids content. At this point if the temperature rises it provides certain problems. When this solution cools, the sugar's solubility decreases and the sugar crystallizes out of solution.

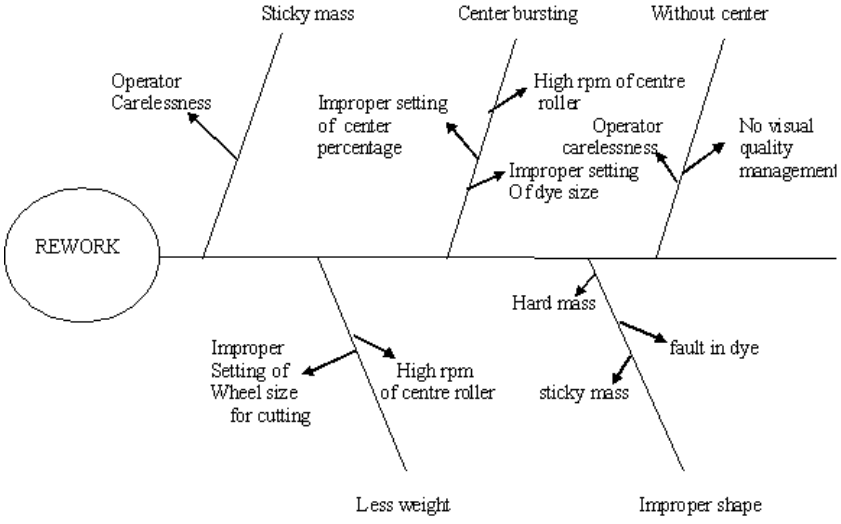

Figure 3: Fish bone diagram that shows the root cause for the rework occurrence

Research Article

Different causes of rework were established manually. A fishbone decision analysis was employed to find that. In that main justification for rework was articulated such as improper personnel supervision, improper setting of centre percentage, fixing the pm at high speed, inaccurate dye setting or fault in dye and no visual quality management systems. This was been clearly established in the fishbone diagram. (Figure 3)
As specified in the table 1 other critical area where the probable rework can be done were monitored and the amount of products deviated from the regular desired work was established in table 4.

Table 4: Critical areas and its rework parameters

Critical area	Particulars	Values in Kgs
Batch roller	**Total mass**	884.88 ± 37.36
	Oil percentage in mass as per STD)	
	Accepted amount of mass in Kg	880.18 ± 37.14
	Sticky Undesirable product in Kg	5.76 ± 5.98
	Centre Percentage (9-12%)	
	Final goods in Kg	854.59 ± 36.94
	Center burst in Kg	12.41 ± 4.32
	Formed Centre filled candy	
	Without centre	14.06 ± 6.37
	Less weight	11.47 ± 7.40
	Improper shape	20.53 ± 11.04
Primary wrapping machine	**Total mass**	816.58 ± 54.18
	Improperly wrapped	99.82 ± 37.85
	Properly wrapped	716.76 ± 72.02
Secondary wrapping machine	**Total mass**	716.76 ± 72.02
	Improperly wrapped	85.82 ± 30.88
	Properly wrapped	630.94 ± 96.60

Data are Mean ± Standard Deviation

The cooked candy base should be light in colour to obtain good colour in the finished product. If considerable discolouration of the sugars has taken place, the candy colour will have a undesirable cast. Candy colours should be bright and appetizing . the colour should be characteristic of the flavour used *(Teunter and Flapper 2003)*. The several reasons for darkening of the cooked sugar mixutre werecooking at a high temperature and low vacuum, delaying the processing of the hot candy in the batch process,

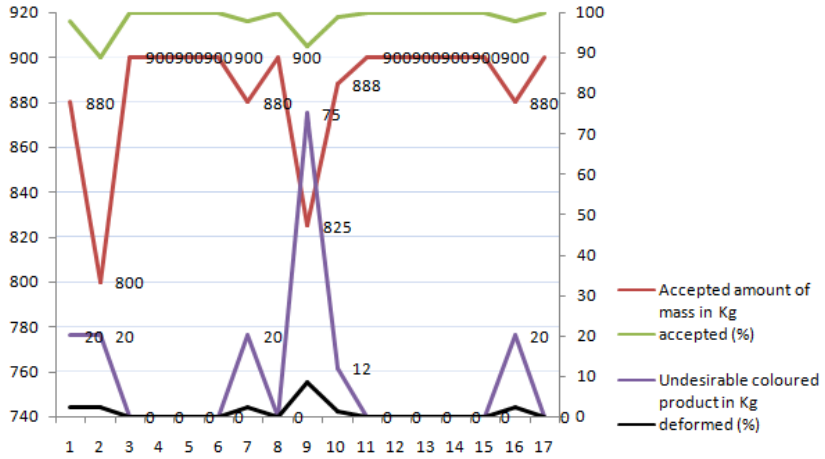

Figure 4: Chart showing deviated colour mass from the critical area cooker

using some lots of corn syrup which do not withstand the heating process as well as others and recycling rework syrup which wastoo dark in colour. Insure the colour consistency of the product by, using uniform strength colours, accurate measurement of colours, uniform batch sizes and prevention of processing delays. The representation of undesirable coloured product is portrayed in figure 4.

Strategies for control of reworks

Cracking wasan significant mistake that pose the rework *(Lindner et al., 2001)* .It wasimportant that contact parts of holding and forming equipment have heaters and that their temperatures be close to that of the candy. If their surface temperatures were too low, the candy surface was cooled, losing its pliability. When the candy wasstretched and formed, the surface cracks, hence the maintenance of the temperatures were needed throughout the batch. Stripes should be even in size and placement. They should be well defined and should not smear, blur, or blend into the candy. Coloured striping candy should have the same temperature and moisture content of the candy batch on which it was applied. If the stripe was too cool or too low in moisture it will crack in the forming operation. If the batch was repeatedly heated for long time inversion takes place and result in smearing.

Striping was also a noteworthy fault which causes the rework of centre filled candy. In the formation of filled hard candy, the batch of candy around the filling pipe must be pliable, evenly tempered and at the correct temperature. If the batch was too cool or too hard the forming dies will not seal the cut ends of the rope together. There will be small holes which will allow some of the hot filling to ooze out.

Leakers were one of the main problems in centre filled candy that roots to rework. The filling can get on the surfaces of the candies, causing stickiness and unsightliness. This problem arises in making a filled pulled candy if candy was pulled too much and becomes somewhat spongy.

Dustiness happens in our set of landscape because of too much vehicle transportation outside the premises. This was a problem that occurs before wrapping *(Minner and Lindner 2004)*. This happens when the weather was too humid. At all stages, the candies should be moved gently to minimize abrasion and breakage.

During the period of low humidity, the dustiness shows up on the surface of the dark coloured wrapped candies. This was due to abrasion of the candy on the transfer discs on twist wrapping machine. The solution was to have humidifying equipment in operation in the wrapping section.

CONCLUSION

By using the above mentioned strategies the occurrence of rework was reduced in the concern areas the total rework time was greatly reduced by 50 Percentage (18.96 mins approx. 19 mins) which was monitored for a weeks' time. This was also help to reduce the rework occurrence in above mentioned areas. From the analysis of various problems that cause the rework during the production in the processing section was finally concluded that the product loss was controlled by making control in rpm of the machine, film thickness, maximum avoid of up & down voltage run on the machine, by scrutinizing good visual quality management and good staff.

Recommendation

Identify the rework material using the application of tags information, which may include name of the product, lot code and date of production also colour coded containers. It was always advised to follow general good storage practices and thus prevents the cross contamination. Always establish the maximum amount of rework material allowable in a product to control the effect of rework on the final formulation. The amount of rework you add should not alter the nutrition content or the ingredient listing of the product. Develop a recording system for rework that includes the time, quantity and processing step it was collected from, the original lot or batch number/code and the code of the lot or batch it was added to and make sure about the communication to all staff about the instructions and procedures on the use of rework and the risks associated with the mishandling of rework material.

REFERENCES

Flapper SDP, Fransoo JC, Broekmeulen RACM and Inderfurth K (2002). Planning and control of rework in the process industries: a review. *Production Planning and Control* **1** 26-34.

Goyal SK and Giri BC (2001). Recent trends in modeling of deteriorating inventory. *European Journal of Operational Research* **134** 1-16.

Inderfurth K, Kovalyov MY, Ng CT and Werner F (2003). Cost minimizing scheduling of work and rework processes on a single facility under deterioration of reworkables. Preprint 30/2003. Faculty of Mathematics, Otto-von-Guericke-University Magdeburg, Germany (accepted by *International Journal of Production Economics*).

Lindner G, Buscher U and Flapper SDP (2001). An optimal lot and batch size policy for a single item produced and remanufactured on one machine. Working paper 10/2001. Faculty of Economics and Management, Otto-von-Guericke-University Magdeburg, Germany.

Minner S and Lindner G (2004). Lot sizing decisions in product recovery management. In: Dekker R, Fleischmann M, Inderfurth K and Van Wassenhove LN (edition) *Reverse Logistics - Quantitative Models for Closed-Loop Supply Chains* Springer 157-179.

Teunter RH and Flapper SDP (2003). Lot-sizing for a single-stage single-product production system with rework of perishable production defectives *OR Spectrum* **25** 85-96.