REVERSE LOGISTICS FOR PLASTIC REPROCESSING INDUSTRIES IN SOUTH INDIA

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ABSTRACT

In South Asian countries like India, small plastic containers are mostly used for packing the consumer products like food, medicine and chemicals. The chemical and waste storage containers are mostly manufactures from recycling plastic granules. In India, recycling plastic granules are obtained from used plastic products and they are collects through reverse logistic process. After an extensive literature survey, the possibilities of complete recycling and remanufacturing of plastic containers in the market by reverse logistics has analyzed and a new logistical method has proposed.

Keywords: Logistics, Reprocessing, Plastics

I. INTRODUCTION

In South Asian countries like India, recycling plastic granules are obtained from used plastic containers and they are collects through reverse logistic process. After an extensive literature review, this study aims to understand the importance of plastic reverse logistic process from recycle plastic manufacturers in Kanyakumari. It is a small district cited in the southern tip of Indian cape of South Asia. This region covers 1671 square kilo meters with 1,870,374 numbers of people as per 2011 census. Nagercoil and Marthandam are the major town areas in this district. In Kanyakumari, most of the plastic industries are small scale industries (SSI) or tiny units and the manufacturers are making the plastic containers and bottles for non food processing goods. The one time use products like waste chemicals and bath room cleaning powders need this type of plastic bottles. Also this types of products need not to pack in high quality packaging as per the quality and economical requirements. After the completion of the technical and marketing survey, different types reverse logistic methods has identified and studied for plastic recycling industries in Kanyakumari to collect the used plastics effectively for recycling. The identified process has useful for remanufacturing of returned goods for manufacturers in economical and quality point of view.

II. PLASTIC MANUFACTURING INDUSTRIES IN SOUTH INDIA – A BRIEF STUDY

The major types of plastic moulding process are blow moulding, injection moulding and extrusion moulding. The small scale industries involving into the above moulding process are always have to concentrate in purchase, sales, manufacturing, marketing and transporting the products as shown in the figure 1. The major duties of purchase department involves the purchase of processing machineries, raw materials and accessaries

for production purpose.

The sales department always concentrates to sale the manufacturing goods for gain the ultimate profit with the desired quality. Each type of plastic products needs seperate moulds or dies to obtain the final shape. The plastic manufacturers may have seperate mould making units or they will create the moulds from seperate mould makers. The blow, injection or extrude machineris involves the manufacturing duties for procuct making. The quality control and coustomer care jobs have controled by marketing departments. Forward and reverse logistic assignments can handled by logistics departments.

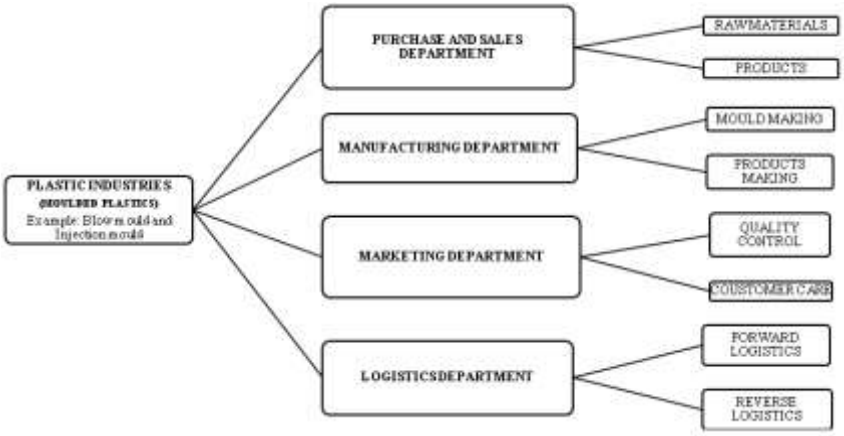

Figure 1. Various Departments in Plastic Processing Industries

In Kanyakumari district, more than 45 plastic and petro based small and micro scale industrial units are available. Nearly 800 people are getting employment from these units. In this district, nearly 40% of the plastic manufacturers are manufacturing plastic products only from reprocessing plastics for non food packaging or consumable applications because of the following reasons.

- Plastic consumers are expecting low price but high quality products for domestic and industrial applications. But the products of above quality have to make from fully automatic machineries with ultimate production capacity and well equipped advance production systems. These types of advance systems are available only in major cities and so that most of the high quality products are delivered for local consumers only from major cities.
- Because of the well planned logistical systems and reduction in product cost of imported items, local consumers preferring imported and transported plastic items for non packaging applications.
- In kanyakumari district, most of the plastic moulding products are manufacturing only by semi automatic or manually operated machineries suitable for packaging applications. The local manufacturers are fully depended on repackaging traders and small scale industrial manufacturers around the township.

III. LOGISTICS PLANS FOR PLASTIC MANUFACTURING INDUSTRIES

Henrique Luiz Corrêa and Lucia Helena Xavier [1] have mentioned the concepts, design and implementation of reverse logistics systems for sustainable supply chains in Brazil. In South India, the logistic plan of SSI plastic moulders has always prefers to reduce the transportation cost. Patricia Oom do Valle, Joao Menezes, Elizabeth Reis and Efigenio Rebelo [2] have studied the customer involvement in the reverse logistics system for recycling household packaging. As per the common logistical method used in South India (known as ‘method 1’), the supplier will choose the way of transportation to distribute the goods by covering maximum customers

in a single transportation in a specified area. In this method the return products will carry by the supplier with separate logistics providers. Marisa P. de Brito, Simme D. P. Flapper and Rommert Dekker [3] indicated the reasons for product returning. They are manufacturing returns, commercial returns, product recalls, warranty returns, service returns, end of use returns and end of life returns. Leo Kroon and Gaby Vrijens [4] have studied the reverse logistics of returnable containers. Aarón D. Castillejo T and Fredrik Stensson [5] have indicated the returnable plastic packaging flow in the automotive industry. In another logistical method, (known as 'method 2'), the delivery as well as return the products will carry in same vehicle for consumers and suppliers. To minimize the transport cost, the plastic distributors always prefers this logistic plan known as single way logistic system (SWLG) by carrying the return good after the product delivery. The description of SWLS has shown in figure 2.

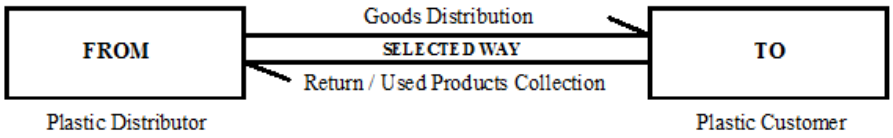

Figure 2. Basic Concept of SWLG

Reza A. Maleki and Jonathan Reimche [6] have studied the logistic and returnable container's physical flow through flow diagram. The blow moulding plastic goods like plastic containers has less weight but covers more space in the stuffing area of vehicle. It creates high transport cost during the time of the delivery of plastic goods. For this case, to control the logistic cost, the following factors must consider during the single way transportation.

- Ensure full load in vehicle for various customers in the same route
- Effective distribution for all customers on the way in simple trip
- Effective return trip with the return goods from the customers.

SWLS covers the forward and reverse logistics of goods in a single trip. The forward trip of SWLS is for deliver the manufacturing goods to multiple buyers and the reverse trip is for collect the used or returned goods. The major consideration for SWLS for plastic industries as follows.

- Trip for delivery goods must arrange only with full stuff in the vehicle
- The trip must covers only selected areas with effective delivery and collection
- The charge of return vehicle must reduce by the effective collection of return goods

Mikko Kärkkäinen, Timo Ala-Risku and Marianna Herold [7] have studied for managing the rotation of reusable transport packaging. Figure 3 shows the step by step approach for single way logistics with multiple customers.

IV. REVERSE LOGISTICS (RL) METHODS FOR REPROCESSING PLASTIC GOODS

Isabel Fernández Quesada [8] has reviewed various papers for study the concepts of reverse logistics. Dale S. Rogers and Ronald S. Tibben-Lembke [9] has studied the reverse logistic activities, reverse flow of goods, classification of reverse logistics activities and importance of reverse logistics. Magdalena Graczyk and Krzysztof Witkowski [10] have indicated the value chain and different kinds of recovery in integral supply chain for plastic products. The production of plastic goods like non food packaging containers needs reprocessing plastic raw materials (RP materials). So that the recycle plastic product manufacturers have

separate RP materials making unit with the other departments indicated in figure 1. Brandon Kuczenski and Roland Geyer [11] have indicated the flow diagram for pet bottle reverse logistic program. The RP materials can obtain from used plastic products through the following five steps involved in recycling process. They are used plastic collection, manual sorting, chipping, washing and pelleting. Chee Wong [12] explains the plastic recycling supply chains and waste handling. The one time used plastic products can obtain from used plastics collection shops. The reprocessing plastic makers have second quality plastic production machineries for produce the raw materials from used plastic products. Yukie Umeda, Hiroshi Tsukaguchi and Yan Li [13] have mentioned the various methods for efficient collection and reverse logistics system of electrical appliances recycling. For used plastic collection process, the manufacturer or logistics provider collects the used plastic from collection shops or from the consumers. This collection process also can carry in the same trip with the product delivery and returned product collection of 'method 2'. This is the third logical method and in this method, the trip will be arranged periodically as per the following requirements

- Customer's product requirements and availability
- Used and returned products availability with customers and / or in collection shops

The comparison of the above three logistical methods as mentioned below.

Method 1: Sending the products to the consumers

Method 2: Sending the products from manufacturers and collection of returned products from consumers in a single trip

Method 3: Sending and collection of products from manufacturers, consumers and waste collection shops in a single trip (suitable for reprocessing plastic industries)

Table 1: Transport Frequency with Respect to Distance

Sl.No	Distance (kilometres)	Vehicle	Operation frequency
1	0 < 5	Light vehicle	frequently
2	5 to 10	Medium vehicle	Weekly or monthly
3	> 10	Heavy vehicle	Well defined time interval

Figure 3. Step by Step Approach for Single way Logistics with Multiple Customers

V. ROUTE MAPPING

Georgiadis.P and Vlachos.D [14] has done the numerical investigation for closed loop supply chain modelling for a reverse logistic dynamic system. Before deliver or return the goods, the route arrangement must define by the transport provider for effective and reliable logistic. Dennis W. Krumwiede and Chwen Sheu [15] mentioned the reverse logistics decision-making model for logistics entry by third-party providers. Most of the SSI plastic manufacturers in Kanyakumari district have their customers around 15 to 20 kilo meters from their production units as shown in figure 4. A typical unit as shown in figure has 11 consumer units and 6 return products collection areas. In this example, the production industry has 4 consumers and 2 recollection units in north-eastern side, 3 consumers and 1 recollection unit in north-western side, 2 consumers and 2 recollection units in south-eastern side and also have 2 consumers and 1 recollection unit in south-western side.

Table 2: Trip Arrangement with Respect to Direction

Sl.No	Trip	Region	Direction	Number of Consumers covered	Number of Collection units covered
1	A	1	NW	3	1
2	B	2	NE	4	2
3	C	3	SW	2	1
4	D	4	SE	2	2

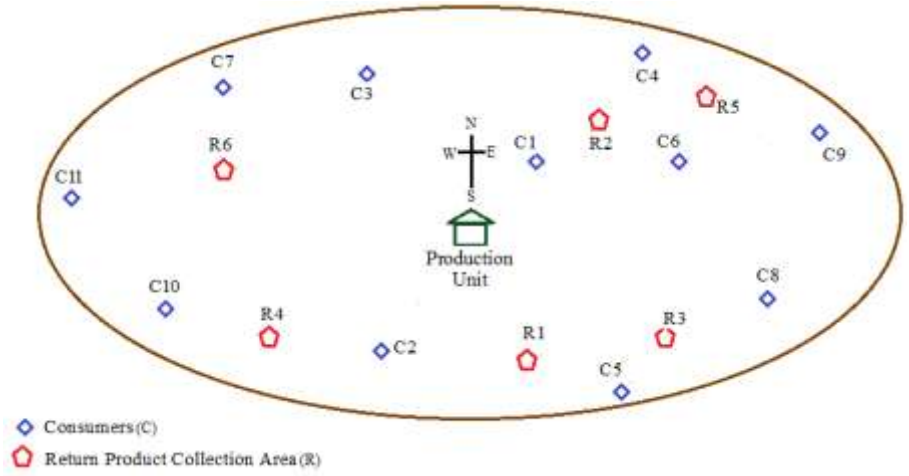

Figure 4 Sample Delivery and Collection Areas

Figure 5 indicates the delivery or collection units as per distance measurements. In the measured unit, 2 consumers and 1 recollection units are available within 5 kilometres. The manufacturer can use the small size transport vehicles for the delivery or collection duties for these units frequently. But for the units available more than 10 kilometres, the heavy vehicles are suitable in the well define time interval to save the transport expenses and to achieve the effective logistic solution. The different types of suitable vehicles with respect to the distance covers by destination as mentioned in table 1.

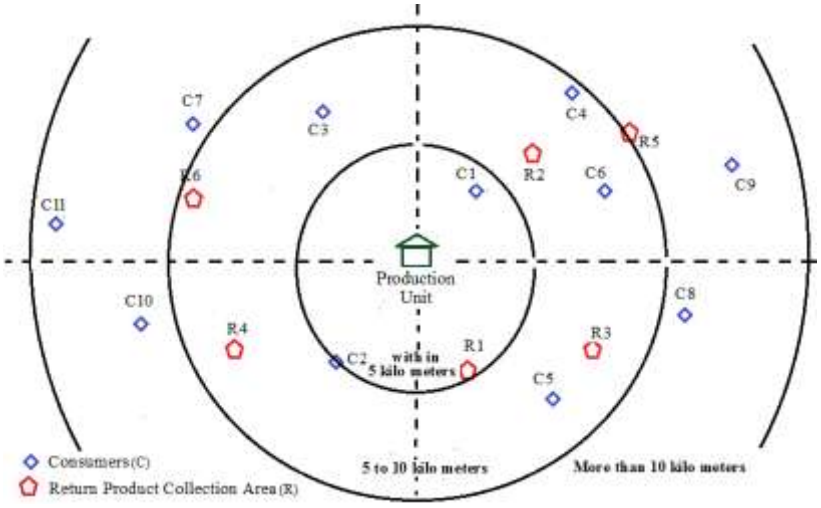

Figure 5. Mapping with Respect to Distance

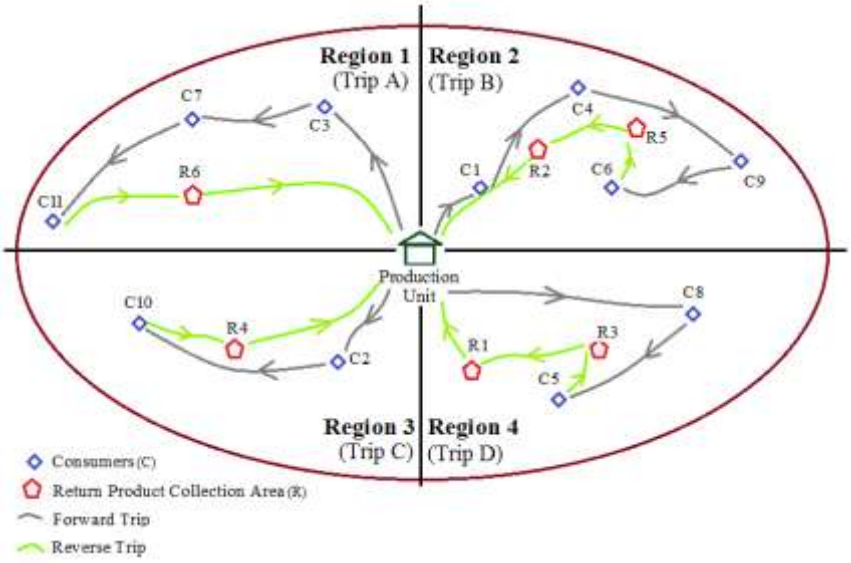

Figure 6. Route Mapping with Respect to Transport Direction

The distance mapping may not suitable for SSI industries unless they have more number of consumers in the above three regions. If the production or collection orders are below the production capacity, the mapping can do with respect to the direction of trip. The figure 6 indicates this type of mapping covers the customers with respect to north-west (NW), north-east (NE), south-west (SW) and south-east (SE) directions. The details of trip has mentioned in the table 2. At least one collection units must cover in each trip and the ultimate prospect of this arrangement is the full stuff in forward and reverse transport with delivery and collection of goods.

VI. CONCLUSION

The proper scheduling in reverse logistic for reprocessing SSI plastic manufacturers is the most important process. This study indicates the various plans for collect and transfers the returned goods during the time of product delivery. The effective transport plans always importance for the growth of industries. The typical plans indicate in this paper explained as the examples. The manufacturers can implement their own logistical plans for their production capacity and consumer intensity.

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