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JSKE INSTRUCTIONS FOR THE FORMAT OF A CAMERA-READY MANUSCRIPT ← Line Space 18pt

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Abstract: Life cycle inventory analysis (LCIA) of recycling system for wastepaper was examined from the point of view of CO_2 emission and energy consumption. The effect of increase of the percentage for wastepaper use was evaluated on production of the recycled paper. Compared with the paper made of 100% chemical pulp, it was estimated that the CO_2 emission of the recycled paper made of 100% recycled pulp would decrease by 45%. Because lignin component of wood is used as fuel when production chemical pulp, the energy consumption would incre... the whole system, the numerical model of the recycling system for wastepaper was ..., pulps and fossil fuel consumption and so on. The effect of increase of the perce... of the recycled paper. Compared with the paper made of 100% chemical pulp, it... paper made of 100% recycled pulp would decrease by 45%. Therefore, to examine t... of the recycling system for wastepaper was constructed with parameters: output of paper products, pulps and fossil fuel consumption and so on. The effect of increase of the percentage for wastepaper use was evaluated on production of the recycled paper. Compared with the paper made of 100% chemical pulp, it was estimated that the CO_2 emission of the recycled paper made of 100% recycled culp would decrease by 45%.

Abstract: Single column Text 9pt, Space 10pt

Keywords: *Life cycle inventory analysis, Wastepaper, Carbon dioxide emission*

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1. INTRODUCTION

The production of paper and paperboard reached 30 million tons in Japan [1]. The usage rate of waste paper of all ...mount of wastepaper should ...g recycled. The waste treatment problem has been becoming serious year after year. In generally, wastepaper makes up about 40 wt % in municipal waste, and it is the biggest rate of all. The waste has almost filled landfill disposal in Japan. In addition, wastepaper has been surplus in the last few years. It is due to efforts to decrease solid urban garbage by municipal corporation's and consumer's movements as well as increase of paper and paperboard import [2-8]. Generally speaking, the recycling is effective for energy saving and reduction CO_2 emission as well as for the reduction of resource consumption. However, paper may be an exception. In a chemical pulp process, much er... ...ered than that consumed in the procGener... the recycling is effective for energy saving and reduction CO_2 emission as well as for the reduction of resource consumption. However, paper may be an exception. In a chemical pulp process, muess because the process uses lignin component of wood as fuel (black liquor). The chemical pulp process has an aspect of biomass energy supplier. For the reasons, careful consideration should be given to paper recycling problem wastepaper usage rate is already coming up to 90% in Japan [9]. It is difficult to increase the rate from both technical and economical and rate from both technical and economical and CO_2 emission in plain paper for copy ... tions were estimated by cha... paper. In addition, to estimate the environmental loads of a wastepaper recycling srate from rate from both technical and economical and both techn ystem, points of view.

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2. EXPERIMENTAL

2.1. Energy consumption and CO_2 emission in recycled paper production.

Environmental loads in recycled paper production were estimated with the amount of energy. The usage rate of wastepaper of all was about 54%, as mentioned above, ...board, the wastepaper usage rate is already ...0% in Japan [10]. It is difficult to increase the rate from both technical and economical points of view. While the wastepaper usage rate for paper is less than 30% [11-13]. These statistics suggested a possibility to decrease eproduction. We focus on environmental loads in the production. In this study, to investigate environmental loads of paper recycling, the amount of energy consumption a numerical model was environmental loads in the production. In this study, to investigate environmental loads of

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in recycled paper production were estimated with the amount of energy consumption and CO_2 emission. Those of two kinds of recycled paper: PPC and newsprint, were calculated by increasing the usage rate of wastepaper. There are three main reasons to be PPC as an object. One of the reason is the wastepaper usage rate of information and office paper such as PPC is less than 20% in present. The other reasons are as follows; PPC will have a growing demand in the future and PPC made from 100% recycled pulp has been placed on sale in recent years. While the reason for employment newsprint is that a newsprint consist of three kinds of pulp; chemical pulp, mechanical pulp and recycled pulp, and it has been consisted of about 40% of recycled pulp.

The amount of energy consumption and CO_2 emission in PPC production were calculated by substituting recycled pulp for chemical pulp in the range from 0 to 100%. As to newsprint production, those were calculated by substituting recycled pulp for mechanical pulp. The usage rate of recycled pulp was changed in the range from 40% to 80%. For newsprint consists of 20% of chemical pulp, 40% of mechanical pulp and 40% of the recycled pulp in Japan.

2.2. The material balance model for wastepaper recycling system

Figure 1 shows a diagram of a material balance model of the wastepaper recycling system in Japan. The Production process of paper and the paperboard are separated in the model, because those usage r
ent; the usage rate of wastepaper a
are 27.2% and 87.8%, respectively [2)].
structed to show the amount of materials among paper production process, paper consumption process and waste treatment process. The amount of each paper and pulp production can be calculated by our model.

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3. RESULTS AND DISCUSSIOM

3.1. Life cycle inventory analysis of wastepaper recycling system

The amounts of CO_2 emission of recycled paper and paperboard production were estimated with life cycle inventory arowing demand in the future and PPC made from 100% recycled pulp has been placed on sale in recent years. While the reason for employment newsprint is that a newsprint consist of three kinds of pulp; chemical pulp, mechanical pulp and have a growing demand in the future and PPC made from 100% recycled eepulp

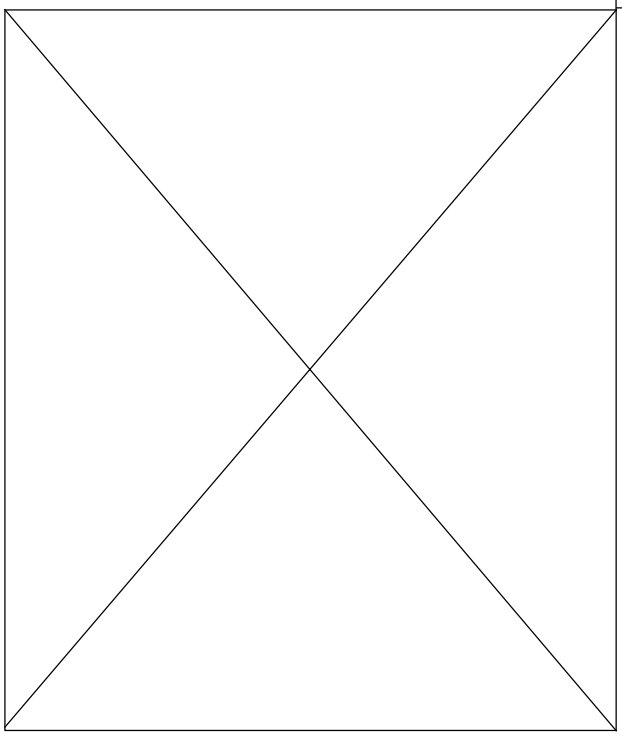

Figure 1: Flow and stock diagram of paper resources for evaluation paper lifecycle in Japan.

The amount of energy consumption and CO_2 emission in PPC production were calculated by substituting recycled pulp for cnalysis. It was calculated using a software: "NIRE-LCA Ver.2" which had been developed by the national institute for resources and environment in Japan. It was developed for the purpose of estimating environmen-
ator. In this analysis, it was consid-
mber process and pulp production
t of CO_2 emission.amount of energy consumption and CO_2 emission. Those of two kinds of recycled paper: PPC and newsprint, amount of energy consumption and CO_2 emission.

3.2. Those of two kinds of recycled paper

PPC and newsprint, were calculated by increasing the usage rate of wastepaper. There are three main reasons to be PPC as an object. One of the reason is the wastepaper usage rate of information and office paper such as PPC is less than 20% in present. The other reasons are as follows; PPC will have a growing demand in the future and PPC made from 100% recycled pulp has been placed on sale in recent years. While the reasOne of the reason is the wastepaper usage rate of information and office paper such as PPC is less than 20% in present. The other reasons are as follows; PPC will have a growing demand in the future and PPC made from 100% recycled pulp has been placed on sale in recent years. While the reason for