

# A Study of Recycle Materials to Develop for Auto Part

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**Abstract**—At the present, auto part industries have become higher challenge in strategy market. As this consequence, manufacturers need to have better response to customers in terms of quality, cost, and delivery time. Moreover, they need to have a good management in factory to comply with international standard maximum capacity and lower cost. This would lead companies to have to order standard part from abroad and become the major cost of inventory. The development of auto part research by recycling materials experiment is to compare the auto parts from recycle materials to international auto parts (CKD). Factors studied in this research were the recycle material ratios of PU-foam, felt, and fabric. Results of recycling materials were considered in terms of qualities and properties on the parameters such as weight, sound absorption, water absorption, tensile strength, elongation, and heat resistance with the CKD. The results were showed that recycling materials would be used to replace for the CKD.

**Keywords**—International auto parts (CKD), Recycling materials.

## I. INTRODUCTION

AUTO part industries have played an important role in Thailand for years. Moreover, these industries have been continued to grow up and become the biggest industries in South East Asia. As the results of expanding industries, they have been demanded more parts to produce cars and need to be imported [1]. This was become the major cost the industries and made manufacturing car more expansive. Since car industries have used several materials to produce them, they have been left over in scrap and waste [2]. These wastes were considered to bring back and used as replacing part for CKD to reduce manufacturing cost [3]. Therefore, the objective of this research was to develop and compare the auto part from recycling materials to CKD in terms of qualities and properties.

## II. PROBLEM FORMULATION

### A. Tool and Material

A literature study of auto part recycle material was

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collected to understand and compare to CKD standard as shown in Table I. After study from literatures, materials used to study in this research were scraps of pu-foam, fabric, and felt. These materials were girded to be mixed with glue in different ratios and forming by hydraulic machine.

TABLE I  
INTERNATIONAL STANDARD

Topic of Parameter	Standard Value
Weight	1000 $\pm$ 100 grams
Sound Absorption	> 63%
Water Absorption	< 20 %
Tensile Strength	> 0.3 Kg/cm <sup>2</sup>
Elongation	> 22.5 %
Heat Resistance	> 0.3 Kg/cm <sup>2</sup>

### B. Design of Experiment

The auto parts recycle materials were consists of pu-foam, felt and fabric crushed to 5 mm diameter. The three different ratios of crushed recycle materials were set to experiment as 20%, 25% and 30% each of them. The samples of each ratio were tested for 30 pieces, which have total of 270 pieces as shown in table II. The result of each sample would be tested to compare with international standard (CKD) parameters such as weight, sound absorption, water absorption, tensile strength, elongation, and heat resistance.

### C. Procedure

The experiment was performed by the following:

- 1) Crushing recycle materials, which were pu-foam, felt, and fabric, into 5 mm.
- 2) Mixing all materials with glue in each ratio shown in Table 2, and forming.
- 3) Forming by 200 tons hydraulic machine, and streaming them at the pressure between 90 and 100 N/sq. meter with the period of time at 70  $\pm$  10 seconds.
- 4) Drying all testing experiments at the temperature of 90 °C of two hours.

## III. RESULT

Results were tested all experiments and compared to six dimensions of international standard of weight, sound

absorption, water absorption, tensile strength, elongation, and heat resistance.

#### A. Weight Comparison

The testing material was cut into pieces by 40\*40\*3 cm. to test for standard weight at 1000 +100 grams. Results on weight comparison between recycle material and CKD were shown in Fig. 1. The all recycle material ratios of auto parts were shown within standard weight value between 900 – 1100 grams with significantly different at the level of 0.05 as shown in Table III. The first ratio of recycle material, which was pu-foam 30%, felt 20%, and fabric 25% was indicated the maximum average weight at 1074.40 grams.

#### B. Sound Absorption

The testing material was cut into 30\*30 mm of diameter and thickness to test for sound absorption. Fig. 2 shows the results for each recycle material ratio. Most recycle material ratios of auto parts were shown higher than standard sound absorption significantly different at the level of 0.05 as shown in Table IV except the ratio number 6. The ratio of material no.3 with pu-foam 30%, felt 30%, and fabric 15% was given the maximum average sound absorption at 70.08%. The ratio of material no. 6 with pu-foam 15%, felt 30%, and fabric 30% was given the minimum average sound absorption lower than the standard.

#### C. Water Absorption

The testing material was cut into pieces by 100\*100\*30 mm. to test for water absorption. Results on water absorption between recycle material and CKD were shown in Fig.3. The all recycle material ratios of auto parts were shown within standard with significantly different at the level of 0.05 as shown in Table V. The ratio of material no. 2 with pu-foam 30%, felt 25%, and fabric 20% was given the minimum average water absorption at 0.66%.

TABLE II  
COMPONENT OF EXPERIMENTAL DESIGN

No. Ratio	PU-foam (%)	Felt (%)	Fabric (%)	Binder (%)
1	30	20	25	25
2	30	25	20	25
3	30	30	15	25
4	25	30	20	25
5	20	30	25	25
6	15	30	30	25
7	20	25	30	25
8	25	20	30	25
9	30	15	30	25

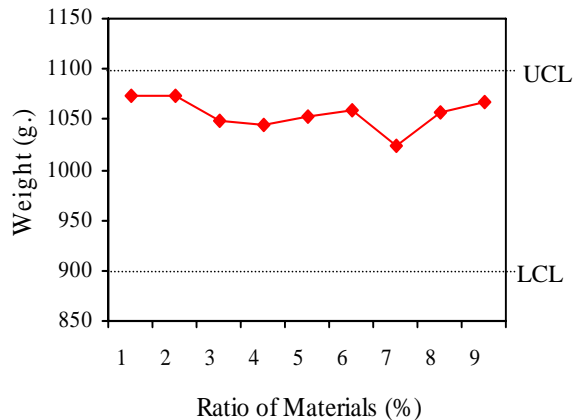


Fig. 1 Weight comparison of recycles material auto part and international standard

TABLE III  
STATISTIC ON WEIGHT COMPARISON

Ratio of Material	1	2	3	4	5	6	7	8	9
Weight	**	**	**	**	**	**	**	**	**

\*\* Significant at the level of 0.05

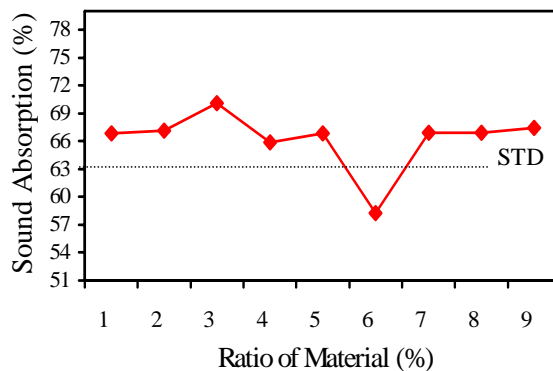


Fig. 2 Sound comparison of recycles material auto part and international standard

TABLE IV  
STATISTIC ON SOUND ABSORPTION COMPARISON

Ratio of Material	1	2	3	4	5	6	7	8	9
Sound Absorption	**	**	**	**	**	-	**	**	**

\*\* Significant at the level of 0.05

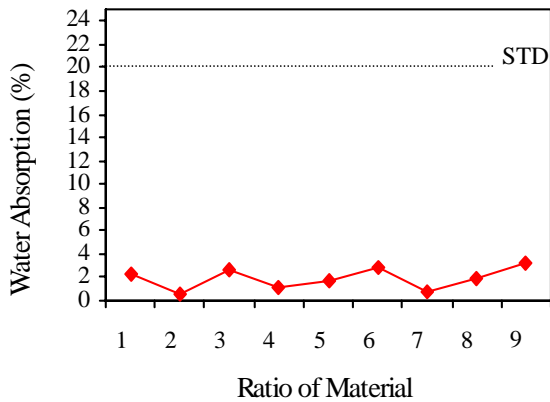


Fig. 3 Water absorption comparison of recycled material auto part and international standard

TABLE V  
STATISTIC ON WATER ABSORPTION COMPARISON

Ratio of Material	1	2	3	4	5	6	7	8	9
Water Absorption	**	**	**	**	**	**	**	**	**

\*\* Significant at the level of 0.05

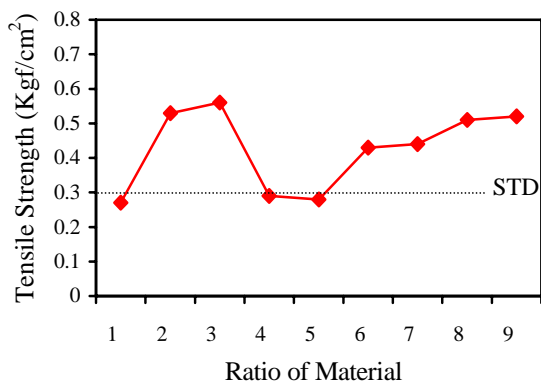


Fig. 4 Tensile strength comparison of recycled material auto part and international standard

TABLE VI  
STATISTIC ON TENSILE STRENGTH COMPARISON

Ratio of Material	1	2	3	4	5	6	7	8	9
Tensile Strength	-	**	**	-	-	**	**	**	**

\*\* Significant at the level of 0.05

#### D. Tensile Strength

The testing material was cut into pieces of 25\*120 mm. to test for tensile strength. Results on tensile strength between recycle material and CKD were shown in Fig.4. The recycle

material ratios of auto parts no 2, 3, 6, 7, 8, and 9 were shown higher than standard at 0.3 Kgf/cm<sup>2</sup> significantly different at the level of 0.05 shown in Table VI. The ratio of material no. 3 with pu-foam 30%, felt 30%, and fabric 15% was provided the maximum average tensile strength at 0.56 Kgf/cm<sup>2</sup>.

#### E. Elongation

The testing material was cut into pieces of 25\*120 mm. to test for elongation. Results on elongation between recycle material and CKD were shown in Fig.5. The recycle material ratios of auto parts no 2, 3, 4, 5, 6, and 8 were shown higher than standard significantly different at the level of 0.05 shown in Table VII. The ratio of material no. 6 with pu-foam 15%, felt 30%, and fabric 30% was provided the maximum average elongation at 28.60%.

#### F. Heat Resistance Comparison

The testing material was cut into pieces of 25\*120 mm. to test for heat resistance. Results on heat resistance between recycle material and CKD were shown in Fig.6. The recycle material ratios of auto parts no 1, 2, 4, 5, 7, and 9 were shown higher than standard significantly different at the level of 0.05 shown in Table VIII. The ratio of material no. 2 with pu-foam 30%, felt 25%, and fabric 20% was provided the maximum average heat resistance at 0.85 Kgf/cm<sup>2</sup>.

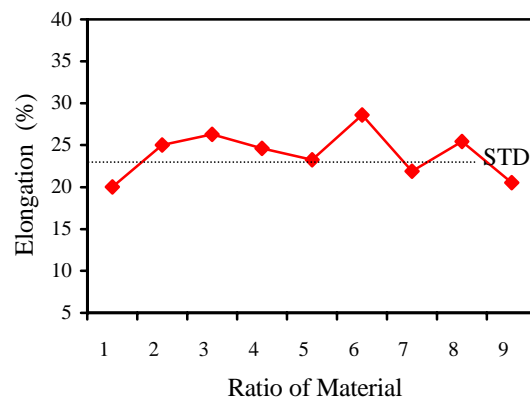


Fig. 5 Elongation comparison of recycled material auto part and international standard

TABLE VII  
STATISTIC ON ELONGATION COMPARISON

Ratio of Material	1	2	3	4	5	6	7	8	9
Elongation	-	**	**	**	**	**	-	**	-

\*\* Significant at the level of 0.05

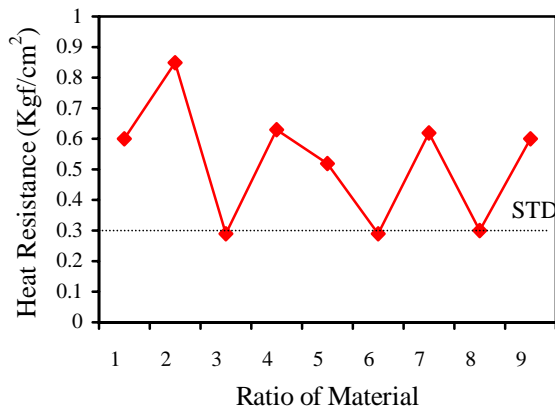


Fig. 6 Heat resistance comparison of recycles material auto part and international standard

TABLE VIII  
STATISTIC ON HEAT RESISTANCE COMPARISON

Ratio of Material	1	2	3	4	5	6	7	8	9
Heat Resistance	**	**	-	**	**	-	**	-	**

\*\* Significant at the level of 0.05

#### IV. CONCLUSION

As the results conducted from the experiment, it could be concluded that recycle material ratio no 2 was the only one ratio statistically passed all requirement comparing to international standard as shown in Table IX. This was indicated that recycle materials auto part ratio no. 2 with pu-foam 30%, felt 25%, fabric 20%, and binder 25% is the best ration solution to develop and replace to CKD in the future.

Based on this study, recycle materials could be used to replace CKD part in order to decrease cost of auto production industries.

TABLE IX  
SUMMARIZING OF RECYCLE MATERIAL PASSED INTERNATIONAL STANDARD IN EACH DIMENSION

Ratio of Material	1	2	3	4	5	6	7	8	9
1. Weight	✓	✓	✓	✓	✓	✓	✓	✓	✓
2. Sound Absorption	-	✓	✓	-	✓	-	-	✓	-
3. Water Absorption	✓	✓	✓	✓	✓	✓	✓	✓	✓
4. Tensile Strength	-	✓	✓	-	-	✓	✓	✓	✓
5. Elongation	✓	✓	-	✓	✓	-	✓	-	✓
6. Heat Resistance	✓	✓	-	✓	✓	-	✓	-	✓
Summary	4	6	4	4	5	3	5	4	5

(✓ = passed international standard)

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