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Production and Fuel Properties of Wood chips from Logging Residues by Timber Harvesting Methods

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I. Introduction

- This study calculated the productivity and cost of extraction and processing of logging residues by cut-to-length(CTL) and Whole-tree(WT) harvesting methods.
- In addition, the comparative analysis of the characteristics of wood chip fuel to examine whether it was suitable for the fuel conditions of the energy facility.

II. Materials and Methods

- Harvesting and processing system: cut-to-length and Whole-tree
- Species used for the study: *Larix kaempferi*

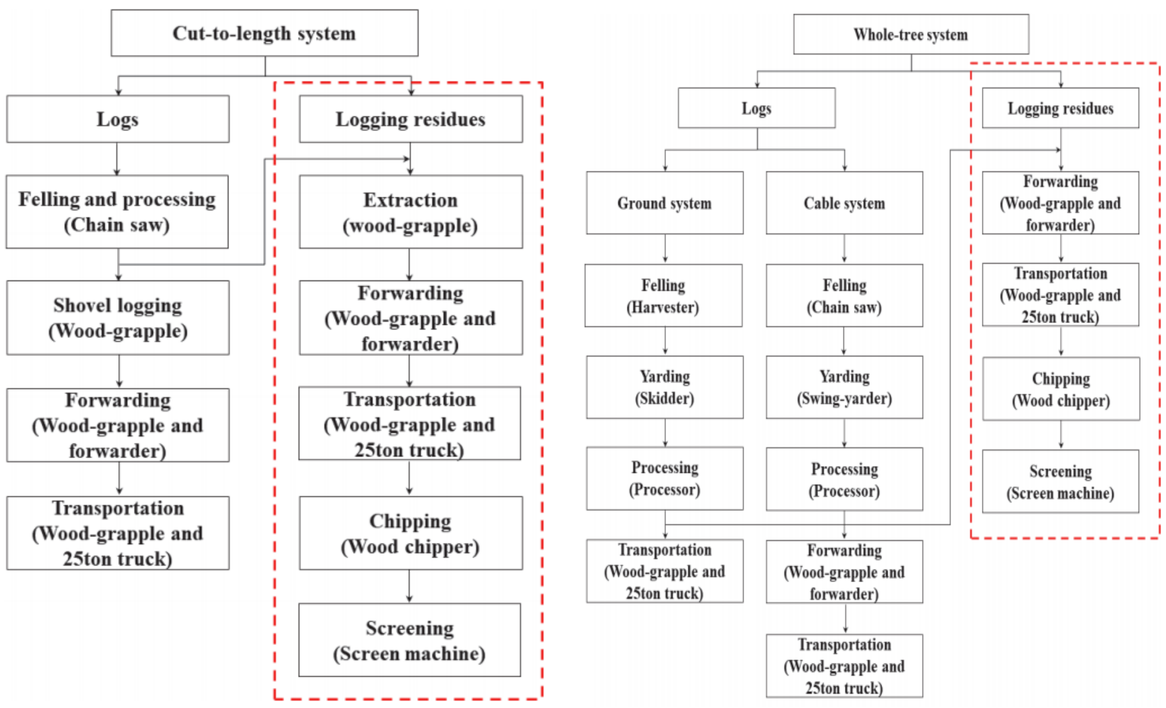

Fig. 1. CTL and WT harvesting and processing system.

- Measurement and data collection
  - Operation time, fuel consumptions, production weight
  - Harvesting and processing productivity(tons/hour), machine cost ($/hour)
- Physical properties of wood chips
  - Moisture content(ISO 18134-1), bulk density(ISO 17828), particle size(ISO 17827-1)
- Chemical properties of wood chips
  - Ash content(ISO 18122), Heating value(ISO 18125)
  - Elementary: Nitrogen(ISO 16948), Sulfur and chlorine(ISO 16994)
  - Inorganic substances(ISO 16968)

Fig. 2. Sampling of logging residues wood chips.

Fig. 3. (L) Physical properties device for wood chips, (R) chemical properties analyzer for wood chips.

III. Results

- CTL harvesting and processing system productivity and cost
  - 1.6 Gwt/hour and $81.7/hour
- WT harvesting and processing system productivity and cost
  - 2.9 Gwt/hour and $66.3/hour

※ The WT harvesting productivity increased 1.3times while harvesting cost decreased by 18.7 compared to the CTL harvesting system.

- The logging residues of wood chips were not suitable for CTL wood chips based on ISO 17225-4:2021 and South Korea Standard (NIFos, 2020), but the quality(A2, Second class) was improved through screening operation.
- The WT-unscreened wood chips conformed to NIFoS(Second class) and did not conform to ISO but were improved through screening operation(Second class).

Table 1. Comparison of ISO and NIFoS graded of wood chips from logging residues by harvesting and processing methods

Property class	Harvesting and processing methods							
	CTL-unscreened		CTL-screened		WT-unscreened		WT-screened	
	ISO 17225-4 (2021)	NIFoS (2020)	ISO 17225-4 (2021)	NIFoS (2020)	ISO 17225-4 (2021)	NIFoS (2020)	ISO 17225-4 (2021)	NIFoS (2020)
Origin and source	forest biomass							
Particle size	P31S		P31S		P31, F10		P31S	
Moisture	A1	First class	A1	First class	A2	Second class	A2	Second class
Ash	n.a.[a]	n.a.[a]	n.a.[a]	Second class	n.a.[a]	Second class	A1	First class
Bulk density	A2	First class	A2	First class	A2	First class	A2	First class
Elemental (N, S and Cl)	n.a.[b]	First class	n.a.[b]	First class	n.a.[b]	First class	n.a.[b]	First class
Inorganic substance (As, Cd, Cr, Pb and Hg)	n.a.[b]	First class	n.a.[b]	First class	n.a.[b]	First class	n.a.[b]	First class
Final class	n.a.[a]	n.a.[a]	A2	Second class	n.a.[a]	Second class	A2	Second class

[a] n.a. : not available, [b] n.a. : not applicable

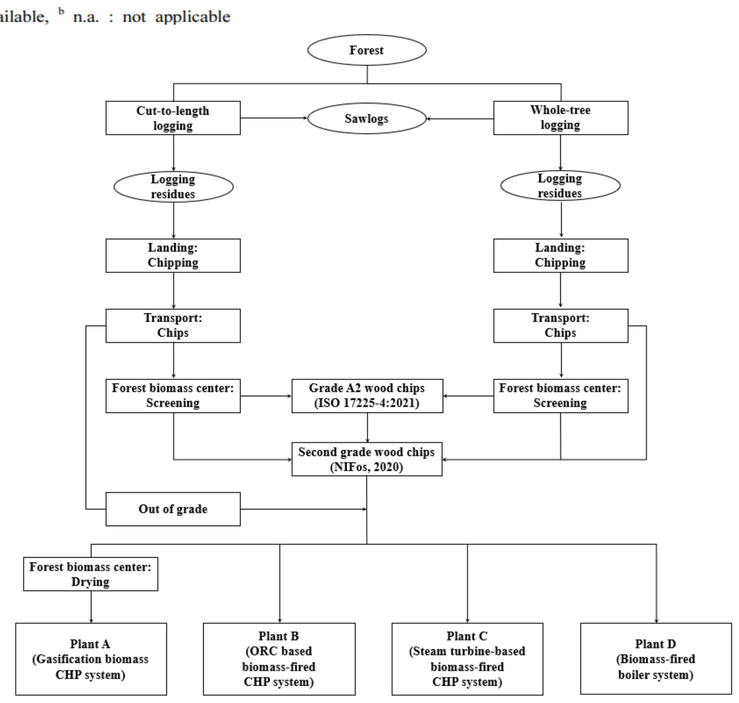

Fig. 4.Logging residues supply chain to improve the fuel chip quality for small-scale biomass plant.

- The energy facility in plant A, all wood chips except CTL-unscreened wood chips were available through drying processing.
- The WT-unscreened wood chips were the lowest at $90.4/tons. Plants B, C, and D had higher moisture content than A, so WT-unscreened wood chips without drying processing were the lowest at $52.0/tons.

IV. Conclusions

- Therefore, the production of logging residues should improve with operation methods that improve quality of wood chips required for applying the variable biomass and energy facility.