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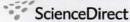


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Fluid selection for the Organic Rankine Cycle (ORC) in biomass power and heat plants

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In small solid biomass power and heat plants, the ORC is used for cogeneration. This application shows constraints different from other ORC. These constraints are described and an adapted power plant design is presented. The new design influences the selection criteria of working fluids. A software has been developed to find thermodynamic suitable fluids for ORC in biomass power and heat plants. Highest efficiencies are found within the family of alkylbenzenes. @ 2006 Elsevier Ltd. All rights reserved.

Keywords: Organic Rankine Cycle; Working fluid; Plant design; Biomass; Cogeneration

1. Introduction

In the last years, large endeavors have been made to extend the market share of renewable energies. Power and heat cogeneration by so d ion ass is one of the most interesting options for a state and reliable energy supply due to its high availability

Electrical power is usually generated in processes based on the Rankine cycle with water as a working fluid. The ORC process uses an organic working fluid instead of water. In contrast to water, the expansion in the turbine ends for most organic fluids not in the wet steam regime but in the gas phase above condenser temperature. Thus, often an internal heat exchanger is used to improve efficiency (Fig. 1).

In comparison to water, organic fluids are advantageous when the maximum temperature is low and/or the power plant is small. At low temperatures, organic fluids lead to a higher cycle efficiency than water. In small plants, organic

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fluids are preferred, as fluid mechanics leads to high turbine efficiency also in partial load [1]. This is the main reason to use ORC for biomass application. Another advantage of ORC in small plants is a legal and economic one. Water shows good efficiency at high pressure requiring increased safety measures which are not economically feasible for

The ORC is not a new concept and many investigations have been carried out [2]. Research was mainly focused on low grade heat. Typical applications use geothermal [3] or waste heat [4,5]. It has also been examined as a bottoming cycle combined with gas turbines [6] or other high temperature cycles.

In most of all biomass applications, octamethyltrisiloxane (OMTS) has been chosen as a working fluid. For OMTS; thermal as well as total heat recovery efficiency is comparatively low for a high temperature ORC process. This is the incentive to search for fluids adapted specially to biomass application which differs from other ORC, as we describe in detail in Section 2.

In order to identify the most suitable organic fluids, several general criterions have to be taken into consideration,

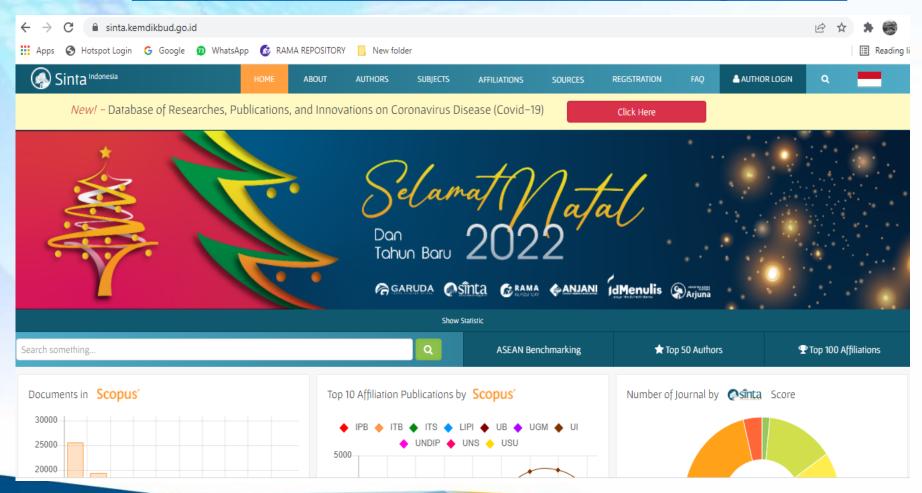


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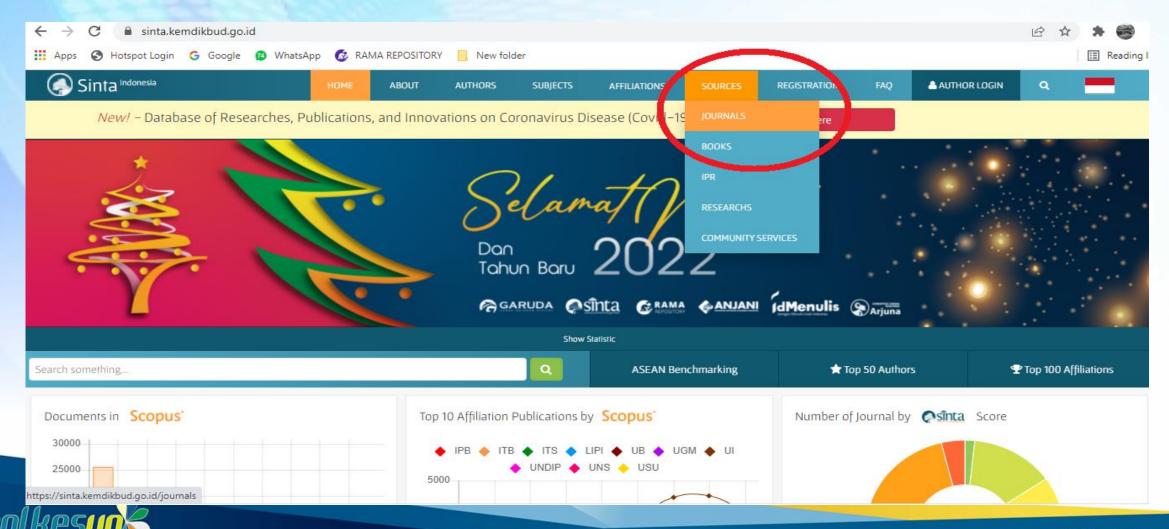
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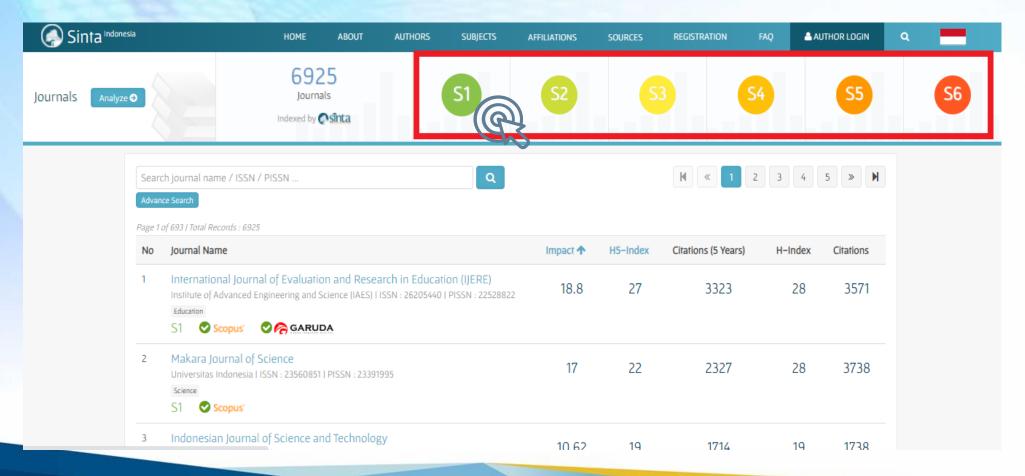
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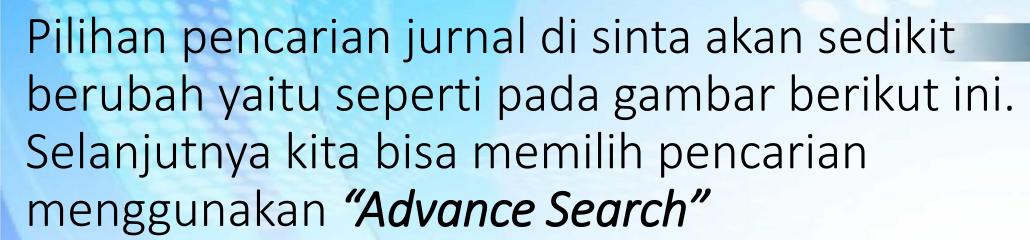


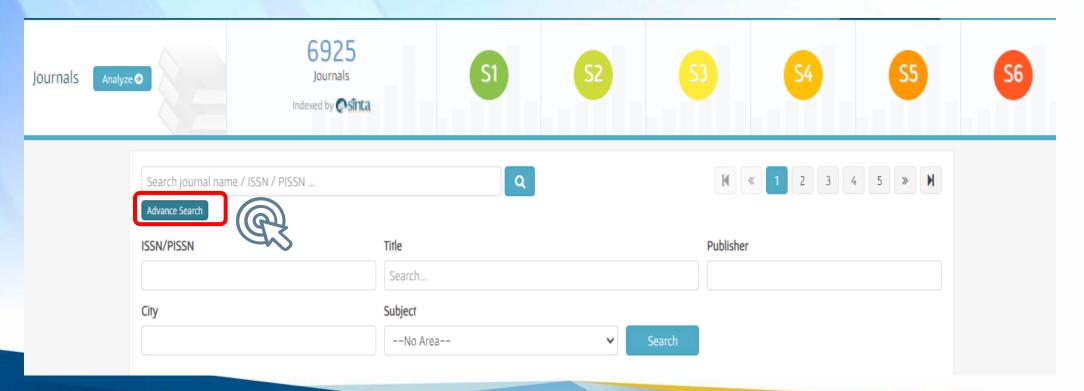
















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