Investigating energy efficient air-conditioning options for agricultural and livestock applications

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Keynote Speakers

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Short Biography

Muhammad Sultan obtained his Ph.D. (2015) and Postdoctoral studies (2017), respectively, in Energy & Environmental Engineering from Kyushu University (Japan). He also did Postdoctoral studies (2019) in Mechatronic Systems Engineering at Simon Fraser University (Canada). He received his Master's in Environmental Engineering (2010) and Bachelor in Agricultural Engineering (2008) with distinctions, from the University of Agriculture, Faisalabad. Currently, he is working as Assistant Professor at Bahauddin Zakariya University, Pakistan. He is also serving as Regional Editor for the Evergreen Journal of Kyushu University. He has authored/co-authored 100+ journal and conference articles. He has published 2 book chapters and edited/co-edited 2 books. His research keywords include HVAC, desiccant air-conditioning, evaporative cooling, adsorption cooling, energy recovery ventilator, adsorption heat pump, Maisotsenko cycle (M-cycle), wastewater, and agriculture and livestock applications.

Investigating energy-efficient air-conditioning options for agricultural and livestock applications

Abstract

For any nation, primary sources of energy consumption are involved in heating, cooling, humidification, dehumidification, ventilation and/or air-conditioning (HVAC), which may be required for various human/non-human applications. Usually developing countries are facing extreme energy shortage, therefore, low-cost and energy-efficient HVAC systems are principally needed worldwide. The low-cost HVAC systems are required not only for humans' thermal comfort but also for various agriculture and livestock applications. It includes (but not limited to) greenhouse dehumidification, livestock (animal) air-conditioning, poultry shed air-conditioning, fruits & vegetable storage, grains & dry fruit storage, storage of hides, tannery air-conditioning, industrial processes air-conditioning, ceiling & structures for agriculture etc.

In this regard, various innovative cooling and air-conditioning technologies have been introduced worldwide. Consequently, in this talk, evaporative cooling and adsorption-based HVAC technologies are explored. These technologies are environmentally safe and can be simply operated by water or low-grade waste heat. The low-grade waste heat can be supplied economically by many ways e.g. solar thermal energy, natural coal, biogas and/or biomass etc. From the prospective of evaporative cooling, the speech focuses on Maisotsenko cycle (M-cycle) based evaporative cooling conception in comparison with conventional direct and indirect evaporative cooling. While adsorption cooling and desiccant air-conditioning systems are focused from the prospective of thermally driven systems. Importance of selection of refrigerant and adsorbent/desiccant is also highlighted. Based on geographic and climatic conditions of countries, role of temporal and spatial variation for the development of sustainable HVAC system is addressed accordingly.

Keywords: Evaporative cooling; adsorption cooling; desiccant air-conditioning; Maisotsenko-cycle; sustainability; agriculture.

Energy-efficient air-conditioning systems for nonhuman applications. In: Ekren O (ed), Refrigeration. London: IntechOpen. Google Scholar. Sultan M, Miyazaki T, Mahmood MH, Khan ZM (2018). Solar assisted evaporative cooling based passive air-conditioning system for agricultural and livestock applications. Journal of Engineering Science and Technology , 13: 693â€“703. Google Scholar. Sultan M, Niaz H, Miyazaki T (2019). Investigation of desiccant and evaporative cooling systems for animal air-conditioning. In: Sultan M, Morosuk T (eds), Low-temperature Technologies, London: IntechOpen. Google Scholar. Agriculture requires energy as an important input to production. Agriculture uses energy directly as fuel or electricity to operate machinery and equipment, to heat or cool buildings, and for lighting on the farm, and indirectly in the fertilizers and chemicals produced off the farm. In 2002, the U.S. agricultural sector used an estimated 1.7 quadrillion Btu of energy from both direct (1.1 quadrillion Btu) and indirect (0.6 quadrillion Btu) sources. However, agricultureâ€™s total use of energy is low relative to other U.S. producing sectors. In 2002... Geothermal, Air Wind Quality and and Solar Energy Livestock Applications in Agriculture Farming and Aquaculture Editors Editors Thomas Banhazi University of Southern Queensland, Toowoomba, Queensland, Australia Jochen Bundschuh UniversityÂ Aland, A. (Andres), editor. | Hartung, Jorg, editor. Title: Air quality and livestock farming / editors: Thomas Banhazi, Andres Aland, Jorg Hartung. Description: Boca Raton : CRC Press/Balkema, 2018. | Series: Sustainable energy developments ; Volume 15 | Includes bibliographical references and index. Identifiers: LCCN 2018008186 (print) | LCCN 2018022011 (ebook) | ISBN 9781315738338 (ebook) | ISBN 9781138027039 (hardcover : alk. paper) Subjects: LCSH: Livestockâ€”Climatic factors. | Energy requirements in agriculture are divided into two groups, being direct and indirect. Direct energy is re-quired to perform various tasks related to crop production pro-cesses such as land preparation, irrigation, interculture, thresh-ing, harvesting, and transportation of agricultural inputs and farm produce. It is seen that direct energy is directly used on farms and on elds. Indirect energy, on the other hand, consists of the energy used in the manufacture, packing and transport of fertilizers, pesticides, seeds and farm machinery (Tab. Air-conditioning should be considered as a basic need in developing countries like Pakistan. It is not only necessary for humans but also for agriculture sector especially for thermal comfort of livestock. Moreover, air-conditioning for the sake of livestock applications is almost negligible in developing countries like Pakistan. In this regard, many direct evaporative cooling systems are used [Show full abstract] conventionally in Pakistan, however, these systems are not feasible in monsoon season and in the humid areas of Pakistan.Â The present study considers desiccant based airconditioning (DAC) options for livestock's thermal comfort. Different heat producing phenomena are described for livestock applications.