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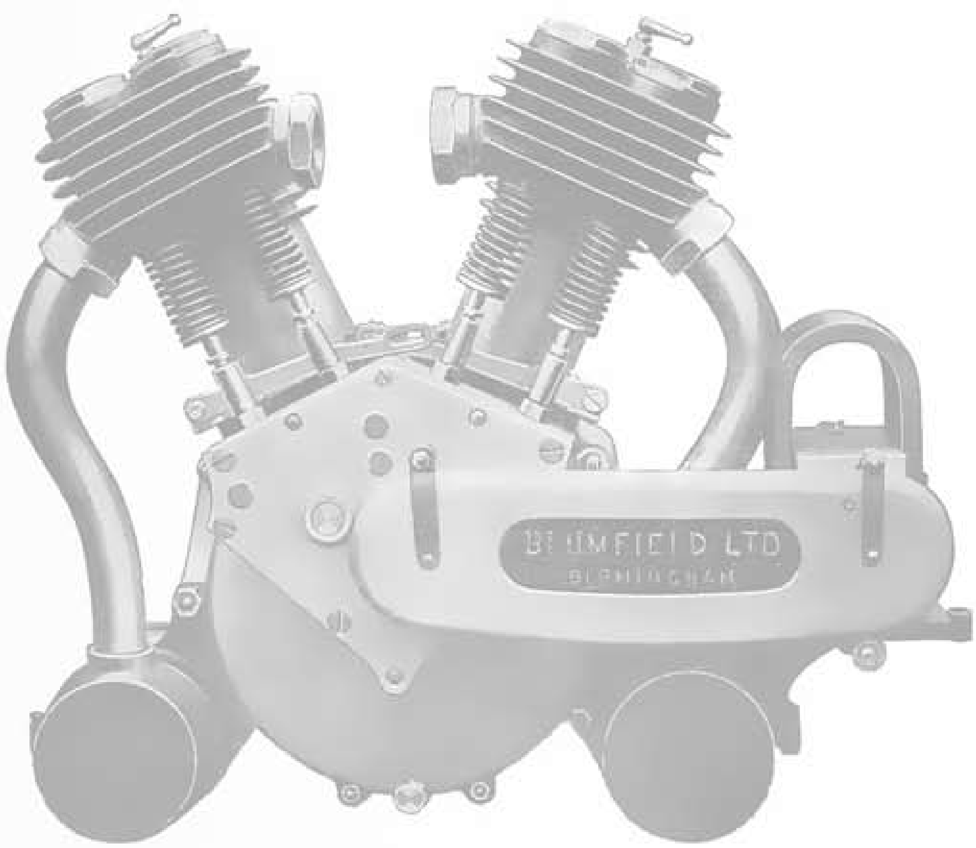
THE DEPARTMENT MAGAZINE

Department of Mechanical Engineering

MECH ZINE

VOLUME 2 ISSUE 1

The Gear of Tomorrow



If its broken, take it apart and fix it.

ACADEMIC YEAR 2015 - 2016

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To become a globally recognized Institution in Engineering Education, Research and Entrepreneurship.

Mission

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IM2	Enrich technical skills with state of the art laboratories and facilities
IM3	Enhance research and entrepreneurship activities to meet the industrial and societal needs

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DM2	Provide platform to apply and analyze the engineering concepts with state of the art laboratories.
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Program Educational Objectives (PEOs)

PEOs	Keywords	Description
PEO1	**Core Competency**	Graduates will adopt technological changes in core and allied areas of Mechanical Engineering.
PEO2	**Professionalism**	Graduates will have leadership quality with soft skills to excel in their professional career.
PEO3	**Higher Studies and Entrepreneurship**	Graduates will evoke interest in higher education and develop entrepreneurial attitude for ever changing industrial and societal environment.

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The Largest Wind Turbine Ever

S.Aravindharaj, II Year, Department of Mechanical Engineering, KSRIET.

Vincent Schellings, a mechanical engineer who is the engineering and product development general manager for GE's offshore wind business was tasked with managing the design and fabrication of the world's largest wind turbine. This article looks closely the Haliade-X that is intended to produce 12 MW at full capacity.

The windmill is a national symbol of the Netherlands, which has for centuries harnessed the fresh breezes coming off the North Sea to pump water and power small industries. It's fitting, then, that a Dutchman was tasked by GE Renewable Energy to manage the design and fabrication of the world's largest wind turbine.

Vincent Schellings, a mechanical engineer who is the engineering and product development general manager for the company's offshore wind business, said the scale of the Haliade-X model is a significant advance from earlier generations of offshore wind turbines. While those existing large turbines can generate 5 to 9 MW each, the Haliade-X is intended to produce 12 MW at full capacity.

The rationale for developing offshore wind turbines is straightforward: Unobstructed by hills and trees, the wind builds up over the ocean to produce stiff and steady breezes.

But installing a wind turbine at sea is expensive, so companies want to put up fewer, taller towers supporting giant nacelles and long blades. Constructing fewer foundations for the towers will save money, Schellings said, adding, "A reduction in the number of installed wind turbines also yields an improvement in the cost to operate and maintain the wind farm."

Over the past decade, manufacturers have met that desire by designing larger and larger turbines. The challenge presented to Schellings was: What's the biggest possible wind turbine we can build? Schellings said his team looked at all sorts of factors—the maximum length of a blade, the height of a tower, how large the nacelle holding the generator could be without being too large for a crane to lift into place, and more.

The team settled on a machine with a 12 MW generating capacity, which would feature three 107-meter-long blades mounted on a 150 m tower.

The swept area of the rotor is equal to about seven football fields. Once those parameters were set, it turned out that the technology needed wasn't so much different from the 6 MW turbine GE already made.

"Our focus was less on component technology, but more on manufacturing technology," he said. "When building components of the size required for Haliade-X you find yourself in a situation where the typical manufacturing processes are either no longer feasible, or might not provide the required quality."

Schellings said that manufacturing even standard components at the physical scale needed for the much larger machine required close cooperation with suppliers. But even though they are his designs, the size of the components is breathtaking. "Based on the first components coming from the supplier's manufacturing lines I can tell you that every single piece of equipment is beyond imagination regarding its size," he said "I keep being amazed again every single day when people send me new pictures."

The first two units are being completed now, with one scheduled to be installed in the coming months.

GE expects each Haliade-X to generate about 67 GWh of electricity a year, or 63 percent of its capacity—a sign that it will be up and running more often than not. Such supersized wind turbines may never be as picturesque as the windmills that still dot the Dutch countryside, but they promise to be an integral part of the 21st century cleans energy mix.

Mechanical fastening systems with disposal means for disposable absorbent

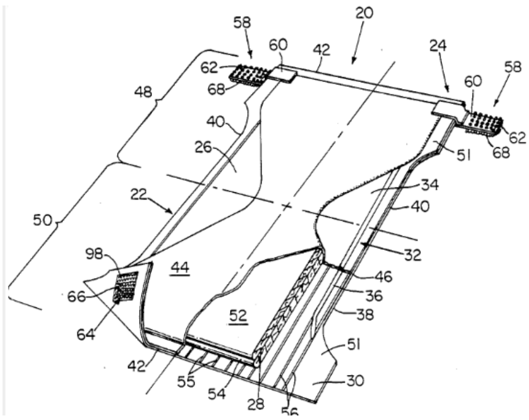
A.R. Arun Kumar, II Year, Department of Mechanical Engineering, KSRIET

A disposable absorbent article with a mechanical fastening system having disposal members so as to provide convenient disposal of the absorbent article. The mechanical fastening system preferably comprises a tape tab having a first fastening element, a landing member comprising a second fastening element mechanically engageable with the first fastening element, and a disposal member for allowing the absorbent article to be secured in a configuration that provides convenient disposal of the absorbent article. The disposal member preferably comprises a second fastening element affixed to the backing surface of at least one of the tape tabs so that the first fastening element of the opposite tape tab will mechanically engage the second fastening element of the disposal member so as to secure the absorbent article in its disposal configuration.

This invention relates to fastening systems for disposable absorbent articles, and more particularly, to an improved mechanical fastening system for such disposable absorbent articles that provides convenient disposal of the absorbent article.

The use of adhesive tape fastening systems for securing the corners of a disposable absorbent article such as a diaper is well known in the art. Examples of these types of adhesive tape fastening systems are described in U.S. Pat. Re. No. 26,151 entitled "Disposable Diaper" which issued to Robert C. Duncan et al. on Jan. 31, 1967; and U.S. Pat. No. 3,848,594 entitled "Tape Fastening Systems for Disposable Diaper" issued to Kenneth B. Buell on Nov. 19, 1974.

Adhesive tape fastening systems provide a secure means for keeping a disposable absorbent article on the wearer during use. In addition, refastenable adhesive tape fastening systems allow the disposable absorbent article to be folded or rolled up into a tight package for disposal, secured in the disposal configuration, and easily disposed in waste receptacles. When such adhesive tape fasteners are secured to the rolled-up absorbent article, the contents of the absorbent article are generally prevented from spilling or leaking out while the absorbent article is being thrown away.



Adhesive tape fastening systems have, however, a number of shortcomings, one of which is that they are easily contaminated by oils and powders that come in contact with the adhesive positioned on the tape tabs such that the adhesive does not readily adhere to the absorbent article with sufficient strength to provide an effective side closure. In addition, an adhesive tape fastening system may cause the backsheet of the absorbent article to rip or tear when the fastening system is unfastened to check if the absorbent article has been soiled or to adjust its fit, thereby leaving a hole in the backsheet that renders the fastening system unrefastenable and the absorbent article unuseable. Thus, it would be advantageous to provide a fastening system that is not easily contaminated by oils and powders, that is more convenient to refasten, and that does not render the absorbent article or the fastening system unuseable after unfastening it.

A number of concepts have been proposed for providing washable diapers with mechanical fastening systems disposed on the body portion of the absorbent article. While mechanical fastening systems, such as hook and loop-type mechanical fasteners, generally provide fastening systems that are not easily contaminated by oils and powders and that are more convenient for refastening than adhesive tape fastening systems, mechanical fastening systems do not provide a disposal mechanism by which the absorbent article may be folded or rolled up into a configuration for disposal, secured in the disposal configuration, and conveniently thrown away. Typically, the hook fastening material is positioned in a first end region of the absorbent article and the loop fastening material is disposed in a second end region of the absorbent article. Thus, when the absorbent article is folded or rolled up for disposal, the loop fastening material is typically tucked underneath other portions of the absorbent article so that the loop fastening material is not exposed such that the hook fastening material is prevented from engaging the loop fastening material. In addition, because the hook fastening material is incapable of being fastened to the exposed areas of the absorbent article, especially the backsheet, the absorbent article cannot be conveniently secured in a configuration for disposal. Thus, it would be advantageous to provide a mechanical fastening system capable of providing convenient disposal of the absorbent article.

It is, therefore, an object of the present invention to provide a disposable absorbent article having an improved fastening system.

It is a further object of the present invention to provide a disposable absorbent article having an improved mechanical fastening system.

It is an additional object of the present invention to provide a disposable absorbent article having a mechanical fastening system provided with disposal means to provide convenient disposal of the disposable absorbent article.

These and other objects of the present invention will be more readily apparent when considered in reference to the following description and when taken in connection with the accompanying drawings.

System monitors radiation damage to materials in real-time

A. Abuthagir, III Year, Department of Mechanical Engineering, KSRIET

In order to evaluate a material's ability to withstand the high-radiation environment inside a nuclear reactor, researchers have traditionally used a method known as "cook and look," meaning the material is exposed to high radiation and then removed for a physical examination. But that process is so slow it inhibits the development of new materials for future reactors.

Now, researchers at MIT and Sandia National Laboratories have developed, tested, and made available a new system that can monitor radiation-induced changes continuously, providing more useful data much faster than traditional methods.
With many nuclear plants nearing the end of their operational lifetimes under current regulations, knowing the condition of materials inside them can be critical to understanding whether their operation can be safely extended, and if so by how much. The new laser-based system can be used to observe changes to the physical properties of the materials, such as their elasticity and thermal diffusivity, without destroying or altering them, the researchers say. The findings are described in the journal *Nuclear Instruments and Methods in Physics Research Section B* in a paper by MIT doctoral student Cody A. Dennett, professor of nuclear science and engineering Michael P. Short, and technologist Daniel L. Buller and scientist Khalid Hattar from Sandia.

The new system, based on a technology called transient grating spectroscopy, uses laser beams to probe minute changes at a material's surface that can reveal details about changes in the structure of the material's interior. Two years ago, Dennett and Short adapted the approach to monitor radiation effects. Now, after extensive testing, the system is ready for use by researchers exploring the development of new materials for next-generation reactors, or those looking to extend the lives of existing reactors through a better understanding how materials degrade over time under the harsh radiation environment inside reactor vessels.

The old way of testing materials for their response to radiation was to expose the material for some amount of time, then take it out and "bash it to pieces to see what happened," Dennett explains. Instead, "we wanted to see if you could detect what's happening to the material during the process, and infer how the microstructure is changing."

The transient grating spectroscopy method had already been developed by others, but it had not been used to look for the effects of radiation damage, such as changes in the material's ability to conduct heat and respond to stresses without cracking. Adapting the technique to the unique and harsh environments of radiation required years of development.

To simulate the effects of neutron bombardment — the type of radiation that causes most of the material degradation in a reactor environment — researchers commonly use ion beams, which produce a similar kind of damage but are much easier to control and safer to work with. The team used a 6-megavolt ion accelerator facility at Sandia as the basis for the new system. These types of facilities accelerate testing because they can simulate years of operational neutron exposure in just a few hours.

By using the real-time monitoring ability of this system, Dennett says, it's possible to pinpoint the time when the physical changes to the material start to accelerate, which tends to happen fairly suddenly and progress rapidly. By stopping the experiment just at that point, it's then possible to study in detail what happens at this critical moment. "This allows us to target what the mechanistic reasons behind these structural changes are," he says.
Short says the system could perform detailed studies of the performance of a given material in a matter of hours, whereas it might otherwise take months just to get through the first iteration of finding the point when degradation sets in. For a complete characterization, conventional methods "might be taking half a year, versus a day" using the new system, he says.

In their tests of the system, the team used two pure metals — nickel and tungsten — but the facility can be used to test all sorts of alloys as well as pure metals, and could also test many other kinds of materials, the researchers say. "One of the reasons we're so excited here," Dennett says, is that when they have described this method at scientific conferences, "everybody we've talked to says 'can you try it on my material?' Everybody has an idea of what will happen if they can test their own thing, and then they can move much faster in their research."

The actual measurements made by the system, which stimulates vibrations in the material using a laser beam and then uses a second laser to observe those vibrations at the surface, directly probe the elastic stiffness and thermal properties of the material, Dennett explains. But that measurement can then be used to extrapolate other related characteristics, including defect and damage accumulation, he says. "It's what they tell you about the underlying mechanisms" that's most significant.

The work is "a clever engineering approach that will allow researchers to characterize the response of a variety of materials to irradiation damage," says Laurence J. Jacobs,
professor and associate dean for academic affairs at the Georgia Tech, who was not involved in the study. He says it is "an outstanding piece of research on a noncontact, nondestructive evaluation technique that enables the real-time, in situ monitoring of the mechanical properties of a material subjected to ion beam irradiation."

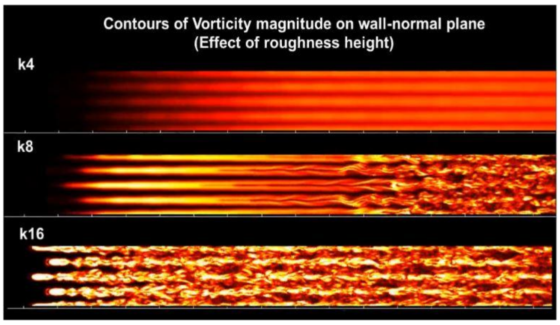
The research was supported by the U.S. Department of Energy, the MIT-SUTD International Design Center, the U.S. Nuclear Regulatory Commission, and the Center for Integrated Nanotechnologies at Sandia National Laboratories.

Exploring how Rough Surfaces cause Fluid Flows to Become Turbulent

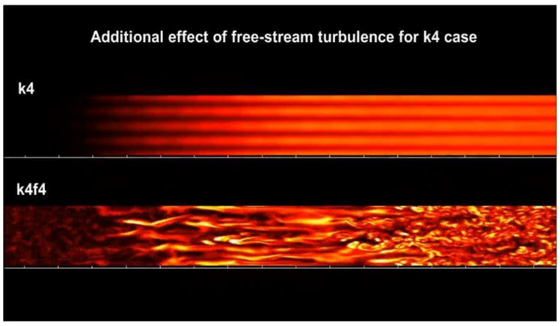
H. Dinesh, III Year, Department of Mechanical Engineering, KSRIET

Tolerance levels are a key consideration for surface finish of various components of gas turbine engines. Such surfaces ought to be sufficiently smooth for efficient performance, and are normally considered to be 'aerodynamically smooth'. As expected, during its working life, various damage mechanisms progressively degrade the surfaces and lead to a decline in performance of the engine, that ultimately translates into higher fuel consumption, excessive temperatures in localized zones, and, under extreme cases, the loss of stall margin. During design, the aforementioned penalties are usually overlooked. As of now, the effect of roughness on fully turbulent flows has been addressed by researchers, but few have addressed the onset of turbulence — which is called laminar to turbulent 'transition'.

Recently, Dr. Nagabhushana Rao Vadlamani and Professor Paul G. Tucker at University of Cambridge in collaboration with Professor Paul Durbin at Iowa State University investigated the effect of distributed roughness on subsonic boundary layers typically observed in turbomachines. Ultimately, applications might be to turbine blades, with loading and a distribution of pressure gradients. But, to elucidate the more basic phenomenon, the Vadlamani et al. study focused on the much more fundamental configuration a flat plate with a pattern of asperites. Their work is currently published in the research journal, *Flow, Turbulence and Combustion.*
The research method was high fidelity computer simulation. It commenced with a thorough description and review of the computational framework, numerical algorithm, and a grid sensitivity study. Then, the researchers explored the effect of surface roughness on transition, validating their simulations by comparisons to correlations that are available from lab experiments. They then engaged in an in-depth investigation of the transition mechanisms. Lastly, they assessed the resultant roughness effects on the spatial development turbulent boundary layers.



The authors observed that the roughness elements that were inside the boundary layer created an elevated shear layer. Alternating high and low speed streaks were observed underneath the shear layer. They noted that secondary, sinuous instabilities on the streaks destabilized the shear layer, promoting transition to turbulence. Moreover, for the roughness topology considered, it was observed that the instability wavelengths were governed by the streamwise and spanwise spacing between the roughness elements.



In conclusion, the Vadlamani et al. study presented a detailed numerical investigation of the transition of a subsonic boundary layer on a flat plate in presence of roughness elements, distributed over the entire surface, using a series of eddy resolving simulations. In general, the underlying transition mechanisms were shown to change significantly with an increasing roughness height. Roughness elements that were higher than the boundary layer were seen to create turbulent wakes in their lee. In that case the scale of instability is much shorter and transition occurs due to the shedding from the obstacles.

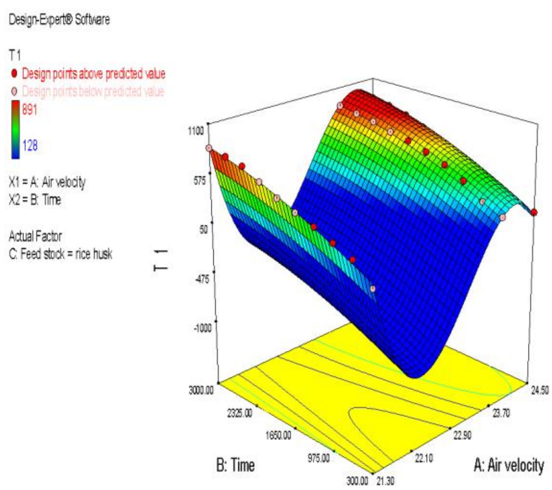
Performance Evaluation of a Forward Curved Blower for Thermal Applications

P. Sabari. IV Year, Department of Mechanical Engineering

This paper presents the performance evaluation of a forward curved blower, for air supply at high temperature thermal applications such as incineration and biomass gasification. For such an application to be successful, and work as intended, the blower and system must be compatible both structurally as well as from a performance standpoint. Tests were carried out in order to determine the performance of the designed blower under actual working conditions. Agricultural wastes such as: groundnut shell, rice husk and bagasse were used to carry out these tests in an existing incinerator. A constant mass of 20 kg each was measured for the variables and fed into the incinerator. The blower was operated at rotational speeds and air velocities of 3203 rpm, 3111rpm, 3078 rpm and 24.4m/s, 23.8m/s, 21.3m/s as measured using a tachometer and anemometer respectively. Temperatures were recorded using two digital thermocouples at 300 seconds intervals. The obtained data were varied at nine levels and laid in randomized complete design (RCD) whi ch was replicated three times for a total of 243 experimental treatments. The Design Expert software version 7.0 was used to analyze and interpret the experimental data. A peak temperature of 891°C was recorded at 3111 rpm and an air velocity of 23.8 m/s. Major characteristics of the blower such as the power output and mechanical efficiency were obtained as 0.56 kW and 62% respectively. The designed blower is suitable for gasification operations which require temperatures of about 750°C.

1. Introduction

A blower is considered to be a particular type of fan specifically a motor – driven centrifugal fan that delivers air or gases to the conditioned space under pressure. Blowers have many applications in which they can be used. For such an application to be successful, and work as intended, the blower and system must be compatible both structurally as well as from a performance standpoint. Major considerations; relating to blower type and performance are: the type, design and rating parameters. Application characteristics are usually reduced to clean or dirty air, normal or high temperature, fume or gas control, low or high erosion, etc.



Several researches have gone into systematic design of centrifugal blowers. Over the years, various authors have suggested different procedures, although each has a slightly different method but the broad underlying principles are similar.

Dhande *et al.* carried out a performance evaluation of a centrifugal blower of air assisted sprayer for orchard pesticide application by designing a forward curved blade and blower casing to deliver the air of 3m^3/s for 35hp tractor . The blade shape, blade inlet and outlet angle and blade inclination angle which have the best performance were considered. Jayapragasan *et al.* analyzed the importance of centrifugal fans role in the proper functioning of a travelling cleaner. The blades of the fan were fixed between the inner and outer diameters. Jayapragasan and Janardhan presented a CFD modeling and experimental investigation of waste collection blower by comparing the analytical and experimental results for forward and radial fan blower with same volute to standardize for both applications. They concluded that the radial blower appeared to be better in centralized waste collection system for higher performance and functionality.

Ehsan *et al.* discussed the Effect of Number of Blades on the Performance of Ceiling Fans by carrying out a parametric study and observed that increasing number of blades while Muna *et al*. discussed and presented an Experimental and Numerical Investigation to study the effect of adding slots to the blades on rotating stall phenomenon and pressure fluctuations in centrifugal blower.

This paper focuses on the testing and performance evaluation of a previously constructed forward curved blower, for air supply at high temperature thermal applications such as incineration and biomass gasification. Performance characteristics such as the: air density, gas velocity, volumetric flow rate and the mechanical efficiency of the blower will be determined through several tests.

The materials used for this performance evaluation are: Rice husk, groundnut shell and bagasse, while the equipment used for these tests were: a blower, an existing incinerator, one (1) digital tachometer DT-2234 B photo type, 0.1 rpm-5-999 rpm, 1 rpm-1,000-99,999 rpm; one (1) Digital Anemometer CT LUTRON SP-8001, one (1) digital stop watch SUNWAY S1-1025, two (2) RKC Rex- C700 digital thermocouples with ranges of 0-1100°C. The blower has a 0.75 hp ATLAS motor mounted and being powered by a 950 Tiger generator. The Design Expert software version 7.0 was used to analyze and interpret the experimental results.

Several tests were carried out in the faculty of engineering, University of Maiduguri in order to determine the performance of the designed blower under actual working conditions. Agricultural wastes such as: groundnut shell, rice husk and bagasse were used to carry out these tests in an existing incinerator. A constant mass of 20kg each was measured for the variables and fed into the incinerator. The blower was operated with rotational speeds and air velocities of 3203 rpm, 3111rpm, 3078 rpm and 24.5 m/s, 23.8m/s, 21.3m/s using a tachometer and anemometer respectively. The ambient temperature was ranging from 29°C to 33°C while the temperatures at points 1 and 2 were recorded using thermocouples at intervals of 300 seconds using a digital stop watch.

The experimental factor considered in this work were agricultural feedstock at three levels (3) rice husk, bagasse, and groundnut shell and operated at different blower speed with an air velocity varied at three levels each (3203 rpm, 3111 rpm, and 3078 rpm) and (24.5m/s, 23.8m/s and 21.3m/s) respectively. A time interval of 300 seconds was considered while the experimental factor was varied at nine (9) levels. The obtained data were laid in Randomized Complete Design (RCD) and was replicated three times making a total of (3×3×3×9 = 243) experimental treatments.

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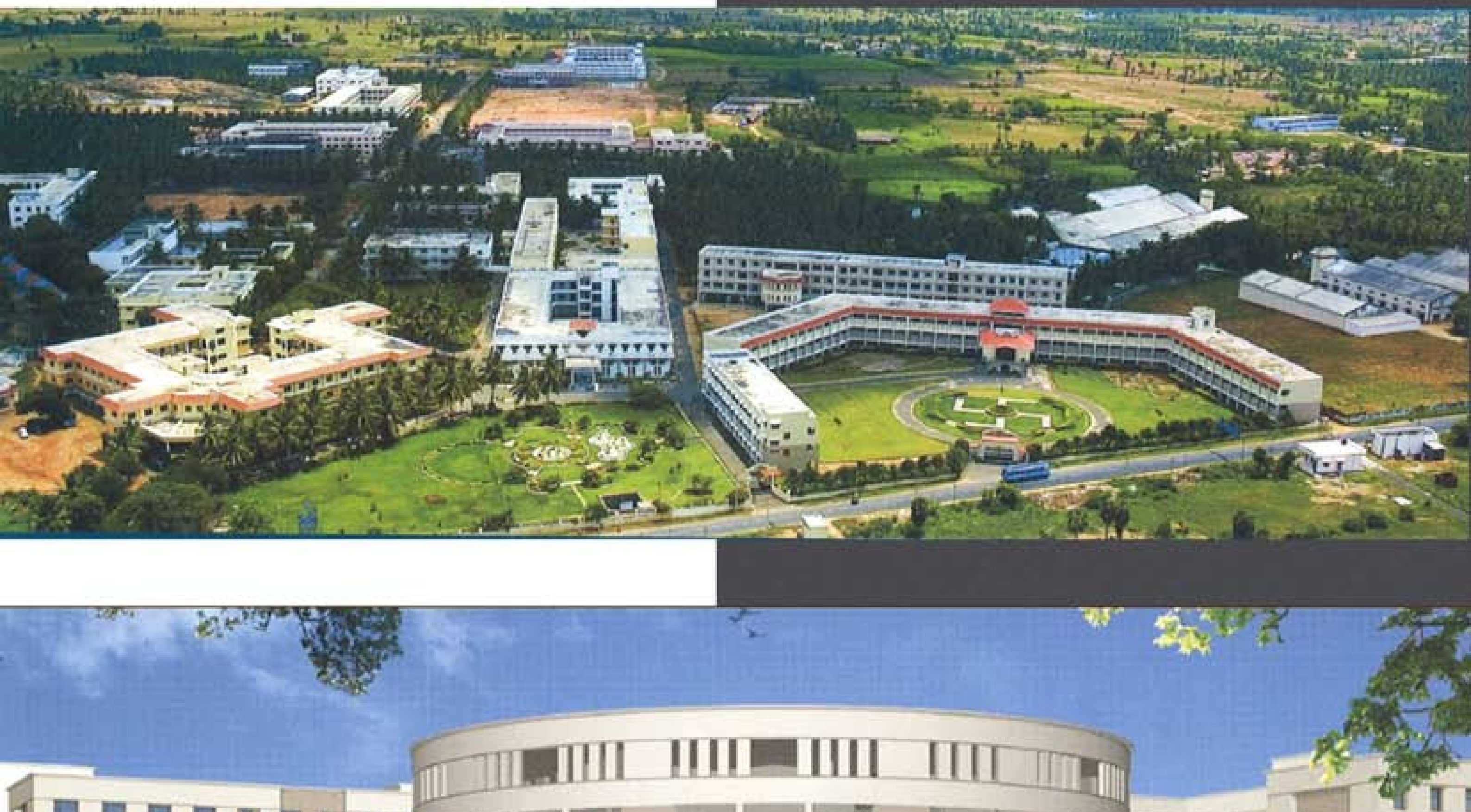

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