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TRANSIENT ANALYSIS OF N-POLICY QUEUE WITH SYSTEM DISASTER REPAIR PREVENTIVE MAINTENANCE RE-SERVICE BALKING CLOSEDOWN AND SETUP TIMES

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Abstract. This paper investigates the transient behavior of a $M/M/1$ queueing model with N-policy, system disaster, repair, preventive maintenance, balking, re-service, closedown and setup times. The server stays dormant (off state) until N customers accumulate in the queue and then starts an exhaustive service (on state). After the service, each customer may either leave the system or get immediate re-service. When the system becomes empty, the server resumes closedown work and then undergoes preventive maintenance. After that, it comes to the idle state and waits N accumulate for service. When the N^{th} one enters the queue, the server commences the setup work and then starts the service. Meanwhile, the system suffers disastrous breakdown during busy period. It forced the system to the failure state and all the customers get eliminated. After that, the server gets repaired and moves to the idle state. The customers may either join the queue or balk when the size of the system is less than N. The probabilities of the proposed model are derived by the method of generating function for the transient case. Some system performance indices and numerical simulations are also presented.

1. **Introduction.** Queueing models with *disaster and repair* have been studied by many researchers in the past few decades as they possess wide applications in modeling many practical situations related to computer networks, communication systems, etc (refer [3], [4], [7], [8], [13], [14], [15], [19], [20], [25]). *Closedown* the system when it becomes empty and *setup* the system before starting the service, play a key role in various real life situations as they support economically to minimize the expenses of an organization. The *preventive maintenance* of the server is essential as it extends the life of the server. Only few works are investigated in literature related to closedown, preventive maintenance and setup times (refer [2], [10], [16]).

2020 *Mathematics Subject Classification.* Primary: 60K25.

Key words and phrases. Markovian queue, N-policy, disaster and repair, closedown and setup times, preventive maintenance, balking and re-service, transient probabilities.

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Transient behaviour of a Markovian vacation queue with re-service balking control of admission closedown and setup times

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Abstract: This paper studies an *M*/*M*/1 queueing model with single as well as multiple vacation, closedown, setup times, re-service, balking and control of admission. All the arriving customers are not allowed to join the queue all the time. They are either permitted to join the queue or rejected. Whenever the system becomes empty and the server resumes closedown work. If any customer joins the queue before the completion of closedown, the closedown work is interrupted and the server commences an exhaustive busy period. Otherwise, it starts the vacation after the completion of closedown period. During the vacation period, the permitted arrivals may join the queue or balk. At the moment of completion of vacation, the server begins the setup work before the commencement of service. After the service, each customer has the option to get immediate re-service. The transient and stationary system size probabilities are derived. The time-dependent mean and variance are also obtained. Numerical simulations are also presented.

Keywords: the *M*/*M*/1 queue; single and multiple vacations; closedown setup times and re-service; balking and admission control.

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Study the influence of cutting parameters on Metal Removal Rate in Turning Process using Tungsten Carbide Tool

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Abstract: In the present study, investigate the influence of spindle speed (N), feed rate (f) and depth of cut (d) on metal removal rate during CNC Turning of Aluminium alloy 6063 using Tungsten Carbide Tools. Experiments were conducted through the Taguchi's Design of Experiments (DOE). Statistical model based on second order polynomial equation was developed for metal removal rate. Analysis of variance (ANOVA) was carried out to identify the significant factors affecting the metal removal rate. The contour plots were generated to study the influence of process parameters as well as their interactions.

Keywords: CNC turning, Metal removal rate, Taguchi method, Mathematical model, ANOVA.

I. Introduction

Traditionally, the machinability of materials involves metal removal rate, tool life, cutting forces, productivity or chip formation, with less attention paid to particle emission. Turning is one such machining process which is most commonly used in industry because of its ability to have faster material removal at the same time produces reasonably good surface finish quality. Material removal rate is an important factor that greatly influences production rate and cost. The material removal rate (MRR) in turning operations is the volume of material that is removed per unit time in mm^3/sec. The effects of machining parameters on MRR in turning process were widely investigated by previous researchers.

R.A. Muley et al., [1] carried out the experiments on AISI D2 round bars they found that the volume of material removed can be achieved better when machining was done at high depth of cut and high feed rate. Depth of cut was found to be the most significant parameter for MRR and Surface Roughness.

S. Dinesh et al., [2] developed an empirical model to predict material removal rate and surface roughness in terms of spindle speed, feed rate and depth of cut using response surface method. The parameter Speed and Depth of cut has significant effect on metal removal rate. The parameter Feed has significant effect on Surface Roughness. They accurate regression model are developed for material removal rate and surface roughness.

Gaurav Pant et al., [3] turning tests were performed on Aluminium Alloy 6063 work piece using three different parameters by taguchi technique. The influences of cutting speed, feed rate, and depth of cut were investigated on the machined surface roughness and Material Removal Rate (MRR).

Er. Sandeep Kumar et al., [4] formulated an experiment using Taguchi to optimize MRR during turning Mild Steel 1018 using coated carbide tool. The experiments resulted with a maximum MRR at optimum cutting parameters and showed that depth of cut has the most significant effect on MRR.

Deepak D et al., [5] formulated an experiment using Taguchi to optimize MRR during turning of Al 6061 using silicon carbide insert. It is observed that the feed rate is most influential process parameters that influence MRR while turning of Aluminum 6061 followed by depth of cut and cutting speed. Machining of the work piece by the supply of coolant is found to produce higher material rate compared to machining without using coolant.

Mohd Shadab Siddique et al., [6] investigated the effect of cutting parameters on AISI 4140 alloy steel and using Taguchi technique. An accurate regression model is developed for material removal rate. They found that feed is the most dominant parameter for MRR.

C. Mgbemena et al., [7] formulated an experiment using Taguchi to optimize MRR during turning of AISI 1018 using HSS. It was found that depth of cut is the most important parameter for MRR. The most important parameters for TWR were found to be the cutting speed and feed.

In this work, influence of process parameters on metal removal rate in CNC turning of aluminium alloy 6063 by carbide tools are evaluated. A mathematical model is developed for predicting the metal removal rate in CNC Turning of aluminium alloy 6063 by response surface methodology. The predicted and measured values are fairly close to each other. Their proximity to each other indicates that the developed model can be effectively used to predict the MRR in CNC Turning of aluminium alloy 6063.

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REVIEW

Industrial and Small-Scale Biomass Dryers: An Overview

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ABSTRACT

The quality of the drying process depends mainly on the efficient use of thermal energy. Sustainable systems based on solar energy takes a leading role in the drying of agro-products because of low operating cost. However, they are limited in use during off–sun periods. Biomass dryer is one of the simplest ways of drying because of its potential to dry products regardless of time and climate conditions. The other benefit is that crop residues could be used as fuel in these systems. However, the major limitation of the dryer is unequal drying because of poor airflow distribution in the drying medium, which can be improved by integrating some design changes in the dryer. This review analyses the two types of biomass dryers: industrial biomass dryers and small biomass dryers for food product, along with their efficiency. Further, studies on technical, sustainability and economic aspects are expected to provide a greater understanding of biomass drying.

KEYWORDS

Biomass dryer; sustainable energy; biomass; direct; indirect; drying time

1 Introduction

Thermal drying is a common method of moisture removal applied in industrial and agricultural processes. Drying is carried out for different purposes: to simplify and reduce the cost of biomass transportations, to increase the material strength, and to ensure easier processing [1]. Drying is an essential technological activity to improve the quality of the product. Drying requires high energy usage, which accounts for approximately 15% of electricity consumption. It is, therefore, very crucial to identify the optimum design and use of the drying process. Biomass, in particular fuelwood, is a predominant form of renewable energy in rural areas. The term biomass sources refer to forest resources, agro-residues, Wastes, and municipal organic sewage, solid waste such as poultry and livestock dung [2]. Biomass moisture content is exceptionally high, somewhere between 50 and 63%, based on the weather, climate, and nature of source. It is, therefore, necessary to dry the biomass to minimize the moisture

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A NOVEL 31 LEVEL CASCADED H- BRIDGE INVERTER

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***Abstract*— Multilevel converter is the high-tech technology for high power medium voltage applications. Inverters are made up off power electronic devices that convert DC quantity into AC quantity. But these devices harvest non-sinusoidal signal and this signal holds harmonics. So as to overcome this problem a multilevel inverter especially in our case we have developed a cascaded multilevel inverter (CMLI) topology in 31-level. We have drafted the recommended inverter topology with the minimum switch count and lower total harmonic distortion [THD]**

Keywords— Multilevel converter, harmonics, CMLI, THD

I. Introduction

The concept of multilevel inverter is a trending concept in the field of power converters. Many researchers start doing their work in this area because of the future scope in industries. It also has a vital role in power electronic drives applications without which the world cannot be driven forward. Also the academicians show their interest and initiate their effort in multilevel inverter. Though it is not available that much in the market it is sprouting in various fields day by day. It spreads it branches with awful advancements. Initially there were two types of multilevel converters. 1. Cascaded H Bridge converter 2. Neutral Point Clamped (NPC) converter. Most recently another type called modular multi-level converter (MMC) came into picture. MLCs are used mainly in medium voltage, high voltage and high power applications. Cascaded H Bridge (CHB) converter Neutral Point Clamped (NPC) converter both are used in medium voltage level. CHB converter is also used in high voltage level like STATCOM in transmission systems. MMCs are mostly used in HVDC applications. They are also introduced in the market in motor drive applications in the lower voltage level.

One of the main applications of the Multilevel Converter (MLC) is motor drive applications where they can produce highly sinusoidal voltage at medium or high voltage range by using many low voltage reliable power devices that are working together.

Initially the development of any power semiconductor devices begins with the low voltage level. For example, when the IGBT was introduced in the market, its voltage rating was 600V. Then subsequently the voltage capability of the device was increased. Now the voltage rating of the IGBT is around 6500V. Since the lower voltage level devices were in practice, the researches and engineers had the better understanding of the properties of the low voltage devices rather than a very high voltage devices. The low voltage power devices were more familiar in concerned with the operation of the device and the design of the gate driver circuit etc. The 600V IGBTs are very popular than 6500V IGBTs. So, low voltage device is better choice for mass production. So present multilevel converters with very high voltage can be developed by using many of these low voltage devices that are working together. This is one of the primary reasons for the multilevel inverter to become popular.

Additionally, with the usage of multilevel converters, filters can be reduced or eliminated. Medium voltage generally starts from 2.3 kV to 33kV beyond which it is said to be the high voltage. So multilevel converters are very popular in this range. Power range may be several MW to several hundreds of MW. MMCs are very popular for HVDC applications where the voltage range is from several hundreds of kW to GW.

Apart from the usage of low voltage devices and the elimination of filter size, the other advantages of multilevel converter are high modularity by which many identical rated devices can be used, redundancy and fault tolerant capacity. Multilevel converter can be operated even when some of the modules are bypassed. This is very advantageous feature. Consider a case, where a huge amount of devices in the multilevel inverter are used and there is a fault in one device, then the whole converter should be shut down. Then it is not very advantageous. It is not good design. So with fault tolerant capacity the faulty module can be bypassed and the converter can be run. The technologies for multilevel converter are matured. They are commercially produced by different manufacturers for different applications like oil & gas, renewables, transport etc. [1].

Multilevel inverter is growing significantly a fascinating option in numerous commercial applications like oil power plant, gas power plant and power quality devices, etc. In 1990s, several researchers started to show more interests on multilevel converters and expressed their ideas in technical papers. Nevertheless, the concept of MLC actually had already started its growth in 1979 and 1983 itself. The main tactical purpose of a multilevel inverter is to integrate a sine wave output voltage from multilevel voltage. The dominant issue with multilevel inverter is the widespread harmonics contained in the output voltage waveform. It is because of the character of the multilevel inverter performance. But the integrated output waveform absolutely imitates a pure sine wave obtained from a multiple cascaded square waves.

The amount of THD in the output waveform is quite the opposite to the count of output voltage levels. So, to lower the THD of the output waveform, the output voltage levels must be enlarged. But to enlarge the output voltage levels, mainly