医疗机构血液透析机维护策略综述

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摘 要：血液透析机是医疗设施中的关键医疗设备，用于以透析治疗的形式进行肾脏替代治疗，以解决撒哈拉以南非洲的慢性肾脏疾病。这是一台至关重要的机器，它通过结合机电控制的体外血液路径来充当人体肾脏，利用泵和半渗透透析器膜来过滤患者的血液。大多数非洲医院的生物医学工程师面临的最大挑战是维持制造商的血液透析设备的安全性和性能规范。需要对血液透析医疗设备进行有效的维护策略，以维持制造商的设定规格，以满足临床期望，从而提高其可靠性。因此，本研究论文的总体目标是分析不同维护策略的影响，进而提高肯尼亚医疗机构血液透析设备的可靠性。该研究将优先考虑血液透析机作为关键医疗设备，并使用全面的二级数据来审查和分析卫生机构中应用的战略维护，以优化血液透析医疗设备的最佳和成本效益的战略维护。蚁群优化（ACO）算法可能不那么依赖专家，并避免了不确定性和模糊性，以确定管理医院血液透析医疗设备的最佳战略维护管理。研究结果将为技术工程师提供一个机会，在医院开发一个预测和智能管理系统，以最小化或消除故障血液透析机的平均停机时间（MDT）和平均维修时间（MTTR），并提高血液透析机可靠性。

关键词：卫生设施；维护；医疗设备

Review in Maintenance Strategies for Haemodialysis Machine in Healthcare Facilities

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Abstract: Hemodialysis machines are critical medical equipment in healthcare facilities for renal replacement therapy in form of dialysis treatment on solving chronic kidney diseases in Sub Sahara Africa. It is a vital machine which acts as human kidney by incorporating electromechanical controlled extracorporeal blood paths that leverage pumps and semi permeable dialyzer membranes to filter the patient’s blood. The biggest challenge to the biomedical engineers in most African hospitals is to maintain the manufacturer’s safety and performance specification of the haemodialysis equipment. There is a need for effective maintenance strategy for haemodialysis medical equipment in order to maintain the manufacturer’s set specification to meet clinical expectations and hence improve its reliability. The overall goal of the research paper is therefore to analyze the influence of different maintenance strategies and subsequently improve on the reliability of hemodialysis equipment in healthcare institutions in Kenya. The research will prioritize hemodialysis machine as critical medical equipment and use comprehensive secondary data to review and analyze the strategic maintenance applied in health institutions to optimize the best and cost effective strategic maintenance for the hemodialysis medical equipment. The ant colony optimization (ACO) algorithms may be less expert reliant and avoid uncertainty and ambiguity to determine the best strategic maintenance management to manage hemodialysis medical equipment in the hospitals. The results will provide an opportunity to technical engineers to develop a predictive and intelligent management system in the hospitals to minimize or remove the Mean Downtime (MDT) and Mean time to repair (MTTR) for a failed hemodialysis machines and improve the reliability of the hemodialysis machine.

Keywords: Health facilities; Maintenance; Medical equipment

1.引言

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2.医疗设备维护管理

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/ MES

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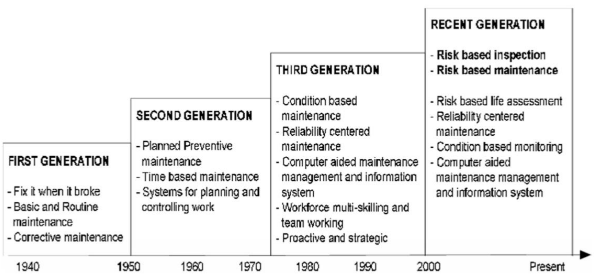

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RCM CBM

James Herbert[21] RCM

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RCM CBM

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3.关键医疗设备维护策略的优化

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ESRD

[25] Khalaf [26

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RCM

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MCDM

RCM

MCDM

Bevilaqua Braglia[32 33] AHP

200

Ratnayake [34] AHP

Ali Azadeh [29]

MCDM

FAHP MCDM

MCDM

Wang [35]

CM PM CBM TBM FAHP

Houria [33] MCDM

FAHP

TOPSIS

Houria [36]

MILP

i ii

iii

1

Paper	Summary	Policies	Objective	Methodology
Ilangkumaran and Kumanan	Focused on selecting an optimum maintenance strategy for a textile industry	PM, CBM, PRM and RCM	Comparison and ranking	AHP and TOPSIS
Arunraj and Maiti	Presented an approach based on risk of equipment failure and cost of maintenance	CM, CBM, TBM and SM	Comparison and ranking	AHP and goal programming
Bashiri et al.	Presented a new approach for selecting optimum maintenance strategy using qualitative and quantitative data	CM, PM, CBM, TBM and PRM	Comparison and ranking	Interactive fuzzy linear assignment method (IFLAM)
Wang et al.	Evaluated different maintenance policies for different equipment	CM, TBM, CBM and PRM	Comparison and ranking	FAHP
Zaim et al.	Showed the applicability of two decision-making techniques in selecting the most appropriate maintenance strategy	CM, TBM and PRM	Comparison and ranking	AHP and ANP
Koochaki et al.	Studied maintenance policies on a plant-wide level	CBM, ABM and BR	Comparison and ranking	Simulation
Ali Azadeh et al.	Performs a comprehensive comparison between different maintenance policies	CBM, TBM, FBM and OM	Comparison and ranking	FAHP-distance-based fuzzy MCDM approach

1.

PRM RCM

SM BR PM CBM

TBM ABM

FBM OM

AHP TOPSIS

FAHP ANP

MCDM

Siew Hong [37] TOPSIS

Fouladgar

[38] COPRAS FAHP

MCDM

MCDM

Al Najjar Alsyouf[39]

Castro [40] PM

T

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Huynh [41]

Marseguerra [42]

GA PM

Bashiri [43]

Jafari [44]

SAW

MSSP

Tiwari [45] ACO

PPS ACO

Mafoud[25]

[12]

[46 24

47] [48]

4.结论

ACO

MDT

MTTR

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用中子照相技术研究玻璃纤维增强聚合物复合材料的均匀性

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摘 要：采用直接薄膜中子照相（NR）技术研究了玻璃纤维增强聚合物复合材料的内部缺陷和均匀性。在这项研究中，中子射线照相（NR）技术用于检测任何样品中的任何斑点或裂纹，因为如果我们通过 NR 在样品中发现任何裂纹或缺陷，这意味着样品不均匀，材料也不完全分布。研究中使用了 3MW TRIGA Mark II 研究反应堆的切向中子射线照相设备。拍摄了一系列中子射线照相图像，以确定样品的最佳暴露时间。在该实验中，最佳曝光时间估计为 40 分钟，并根据样品的射线照相图像；我们发现样品中没有发现斑点。通过测量任何样品的光学密度，我们可以检测该样品的均匀性。已经发现样品的不同参考位置的光密度值是不变的，并且还发现样品的中心位置和参考位置的光学密度值是相同的。这些证明了玻璃纤维增强聚合物复合材料的相关溶液不是均匀扩散和分布的。从最佳曝光时间下样品的中子射线照相图像观察和不同位置样品的光密度观察，发现玻璃纤维增强聚合物复合材料均匀分布，在射线照片中观察到的复合材料中未发现空隙、缺陷和裂缝。因此，发现复合材料的元素分布几乎均匀。因此，玻璃纤维增强聚合物复合材料的制备是完美的。

关键词：中子射线照相术；光学密度；均匀性；内部结构；缺陷

Study of the Homogeneity of Glass Fiber Reinforced Polymer Composite by Using Neutron Radiography Technique

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3Department of Physics, Shahjalal University of Science & Technology, Sylhet, Bangladesh

Abstract: Direct film neutron radiography (NR) technique has been used to study internal defects and homogeneity of glass fiber reinforced polymer composite. In this study, neutron radiography (NR) technique is used to detect any spot or cracks in any sample because if we find any cracks or defect in the sample by NR, it means that the sample is not homogeneous and the materials are not perfectly distributed. Tangential Neutron Radiography Facility of 3MW TRIGA Mark-II research reactor has been utilized in the study. A series of neutron radiography images were taken to determine the optimum exposure time of the sample. In this experiment, the optimal exposure time is estimated at 40 min and from radiographic images of the sample; we see that there were no spots found in the sample. By measuring the optical density of any sample we detect the homogeneity of this sample. Optical density values of different reference positions of the sample have been found to be unchanged and Optical density values of the central positions of the sample and the reference positions have also been found to be same. These prove that associated solutions of glass fiber-reinforced polymer composite are not diffused and distributed uniformly. From the observation of neutron radiographic images of the sample at optimum exposure time and optical density of the sample at a different position, it revealed that the glass fiber-reinforced polymer composite is uniformly distributed and no voids, defects, and cracks could be found in the composite observed in the radiograph. Thus the elemental distributions of the composite are found to be almost homogeneous. So, the fabrication of the glass fiber-reinforced polymer composite is perfect.

Keywords: Neutron radiography; Optical density; Homogeneity; Internal structure; Defect

1.引言

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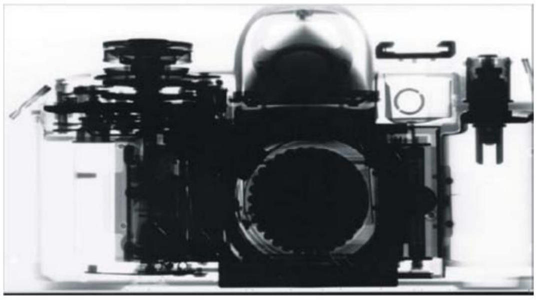
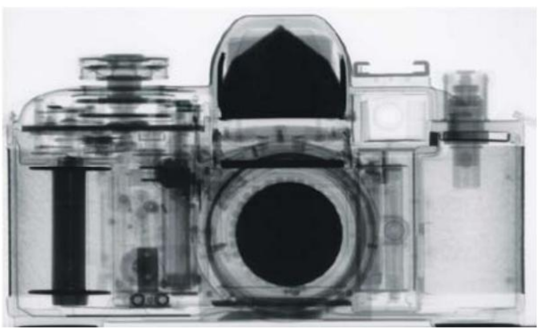
2 X

X



1. X [2]



2. [2]

NR

X

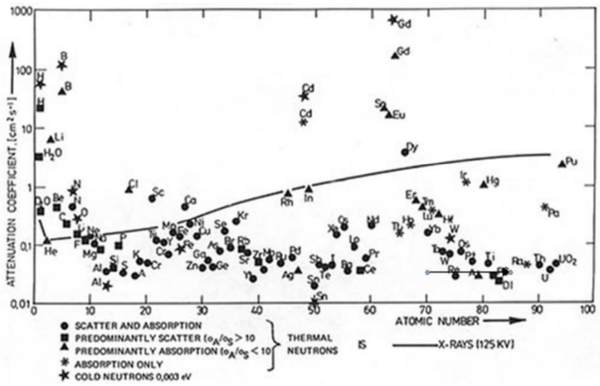
NR

NR NDT

X x

3

x



3. X [3]

NR Islam

[4] Peterka [5]

Ahasan [6]

Islam [7]

AERE 3.0MW TRIGA Mark II

NR AERE

NR Rahman [8] Ahsan [9]

Azad Rahman

[10] Shahajan Miah

Nokia-3120

RAM DDR-2 [11] Khurshed Alam

[12] Mbumbia

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S Zheng [21]

Mehdi Khanzadeh Moradllo

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2.实验设施

3MW TRIGA Mark
II /

2.1.
BAEC TRIGA NR
15 cm Bi
[12 23]

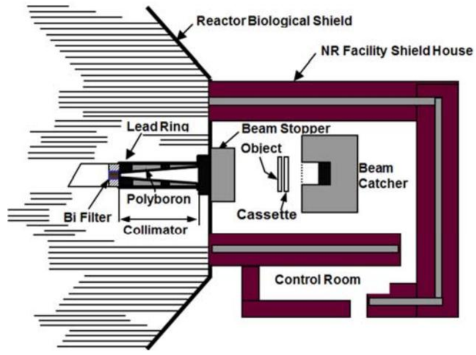
2.2
120
5 10
[12 23]

2.3.
24
33 [12 23]

2.4.
68 cm×40 cm×68 cm
3:1 [12 23]

2.5.
[12 23]

2.6.
100cm × 100cm × 85 cm
30 × 30 × 30
30 × 30 × 15 125
968 [12,23]



4 [25 26]

2.7
NR
1:3:3 3:1
3.0 6.5 NR
[24 25 26] AERE 3 MW TRIGA
Mark II 4

3.实验方法

A

B

3.1.

1. /
2. NR
3.

3.1.1. /
Halfen Moment India Pvt.Ltd

3.1.2 NR
25µm Gd NR
Agfa structruix D4DW X
NR

3.1.3

3MW

/

3.2.

[4 5 6]

4.

/

[25 26] /

D

$$D = \ln\left(\frac{A_0}{A}\right) \quad (1)$$

A_0 A

ΔD

$$\Delta D = \left(\frac{D_c - D_n}{D_c}\right) \quad (2)$$

D_c D_n

-07-424 S-23285 Victorian Inc.

5.

5.1. /

AERE 3MW TRIGA

MARK-II

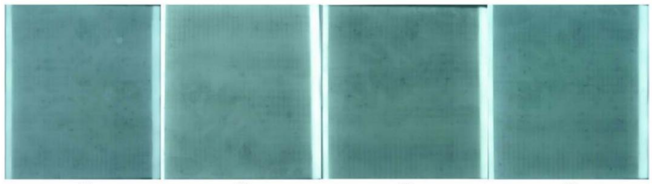
3MW 25

1

/ 40

Samples	Irradiation time (minute)	Optimum irradiation time (minute)
Glass-fiber-reinforced polymer composite	45	40
	35	
	50	
	60	
	40	

1. /


(a) (b) (c) (d)

5 a 40 b 45

c 50 d 60

Samples	Optical density at the center	Average density (D_c)	Optical density at the different positions (D_n)	The fractional change in image density $\Delta D=(D_c-D_n)/D_c$
Glass fiber-reinforced polymer composite	1.88	1.68	1.68	0.000
	1.88		1.68	0.000
	1.86		1.66	0.011
	1.88		1.68	0.000
	1.88		1.68	0.000

2.

5.2.

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Different level	Optical density					
1	1.88	1.95	1.91	1.84	1.84	1.85
2	1.67	1.61	1.81	1.76	1.61	1.68
3	1.58	1.51	1.63	1.61	1.51	1.53
4	1.53	1.52	1.64	1.64	1.53	1.47
5	1.76	1.89	1.73	1.68	1.73	1.71

3.

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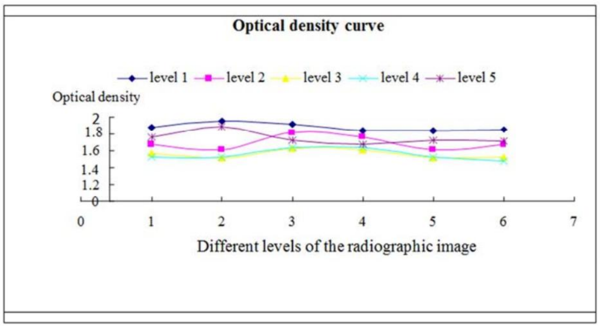
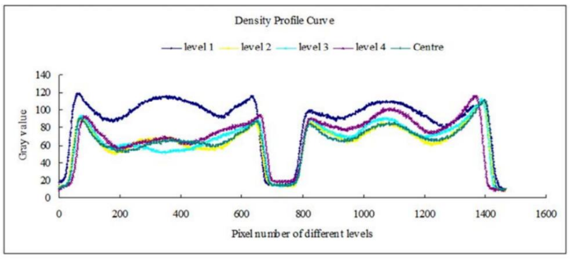


6



7.

6.结论

20 30

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