بسم الله الرحمن الرحيم

الآيـــــــــــــة

قَالُوا حَرِّقُوهُ وَانْصُرُوا آلِهَتَكُمْ
إِنْ كُنْتُمْ فَاعِلِينَ {68} قُلْنَا
يَا نَارُ كُونِي بَرْدًا وَسَلَامًا
عَلَىٰ إِبْرَاهِيمَ {69}

{ صدق الله العظيم }

سورة الانبياء الايه ***69 – 68***

Dedication

To my parent

Whom they sacrificed for me

To my wife

Who flooded me by her love and her tenderness

To my daughter

Light of my life

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Now I have the pleasure and joy to take this opportunity to thank all people who have supported me during years of work that leads to this thesis. I am deeply indebted to those who have helped make this dissertation a reality.

Firstly I would like to thank Sudan University of Science and Technology (SUST).for accepted me as a master degree student in mechatronics engineering.

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Abstract

This thesis aims to improve the boiler firing in practical; boiler firing is multivariable process, still controlled by conventional control strategies. Boiler is pressure vessel designed to heat water or produce steam. The efficiency of the boilers is depending of quality of the material in addition of the good firing; the main elements of the boiler fire which are fuel, air and heat. The good firing in the oil firing boilers is depending on good combustion or fuel to air ratio. The bad firing on the boiler cased in many reasons one of these reasons is fuel to air ratio when air is more than or less than the demand. The bad firing due to increasing air supply causes mainly boiler's vibration, large sound in addition to loss of flame and stop burners and it also leads to Increasing in exhaust gas temperature and environment pollution. The air supply has economical effect hence it causes the optimizing of fuel consumption to enhance firing by added new primary air system which enhances the shape of flame. The primary air supply source is a downstream of main FD fans and configure the logic control of the primary control damper by PID in the existing DCS and sending commands to primary air fans and their convertors and bypass damper also for the existing DCS control system, the secondary air damper of the burner should be opening during burner flame on. From the comparison of the measuring parameters we observe the enhancing happen by indication of the air –fuel ratio increasing value 0.673 than the previse value, indication of decreasing of outlet gas temperature in one to six degree for the previse value, also Oxygen content in out let gas was decrease between the range 0.002 and 0.011 from the previse values and no abnormal sound happen and vibration minimize about 0.213mm/s form the previse value.

المستخلص

تتناول هذة الرسالة الاحتراق فى الغلايات لمحطات توليد الكهرباء لاهميتها فى إنتاج الكهرباء و زيادة كفاءة التوليد الحرارى ، عموما تستخدم الغلايات فى انتاج البخار الذى يقوم بإدارة التربين لانتاج الحركة فى العمود المقترن بالمولد وهى الحركة المطلوبة فى انتاج الكهرباء وفق لقانون فلمنج لليد اليسرى (التيار - الحقل المغناطيسى - الحركة)

للإحتراق عموما له ثلاثة مصادر رئيسية حتى يحدث وهى **الحرارة و الوقود و الهواء** (الاكسجين) ولتحسين الاحتراق تم تركيب نظام سحب هواء إضافى **يعرف بنظام الهواء الاولى للإحتراق** مأخوذ من مدخل الهواء الرئيسى للاحتراق بعد مراوح السحب القسرى

و لتقليل درجة حرارة غازات العادم و تقليل إهتزاز الغلاية وضبط نسبة الوقود للهواء للإحتراق المثالى تم إضافة نظام الهواء الاولى والذى يتكون من مروحتى سحب للهواء تعمل عندما تكون الغلاية فى حالة الحمولة الدنيا و صمام موازى لهما يعمل فى حالة تكون الغلاية فى حالة الحمولة القصوى تم تثبيتها فى منصف أنبوب نقل الهواء وكما تم صمام تحكم قبل الموقدات او الشعلات لضمان توزع الضغط بالتساوى عليها و يعمل هذا النظام على نقل الهواء بنسبة لا تذيد عن 8% من الكمية هواء الاحتراق الكلى للغلاية تم التعديل فى كل الموقدات او الشعلات وذلك بإضافة مسار هواء للنظام المضاف عند كل شعله تم تضمين تهيئة تحكم النظام المضاف فى نظام التحكم القديم وهو نظام التحكم الموزع كما تم تركيب عدادات قراءة الوقود و حساسات قياس الضغط عند كل موقد او شعلة و ذلك للتاكد من الاداء الفردى لكل منها

كما تم أخذ القراءات عند الحمولى القصوى و عمل مقارات ببعض القراءات السابقة ، ومن القراءات المأخوذة اتضح لنا انخفاض فى درجة حرارة الغاز الخارج من المدخنة تراوح بين درجة واحدة الى ست درجات مئوية ، كما تقلص كمية نسبة الاكسجين المتواجد فى الغاز الخارج من المدخنة تقلص ما بين 0.002 و 0.011 ، كما تم مقارنة الاهتزاز فى البويلر والمقارنة مع قراءات سابقة ليتضح لنا ان هناك انخفاض فى قيمة الاهتزاز الى القيمة (0.213mm/s)

، ايضا هناك مؤشر هام وهو نسبة الهواء للوقود فى عملية الاحتراق تلاحظ ان زيادة فى النسبة بقيمة قصوى للزيادة بلغت 0.673 مما يوحى على التحسن للإحتراق.

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List of Symbols	
Sample	Description
λ	Excess Air Percentage

List of Abbreviations	
Abbreviation	Description
AO	Analog Output
AI	Analog Input
BFP	Boiler Feed water Pump
COM	Communication Port
DI	Digital Input
DO	Digital Output
DPT	Differential Pressure Transmitter
DCS	Distributed Control System
DPU	Data Process Unit
DAS	Data Acquisition System
D/MA	Digital Manual Operator
ENG	Engineer
ES/MA	Enhanced Soft-Manual Operator
FARC	Fuel Air Ratio Control
FD fan	Force Draught Fan
FSSS	Furnace Supervision and Safety System
HMI	Human Machine Interface
HSU	History Station Unit
HRSG	Heat Recover Steam Generator
I/O	Input / Output

IEEE	Institute of Electrical and Electronics Engineers
KNPS	Khartoum North Power Station
KBML	Key board Analog Manual Increment/Decrement
LAN	Local Area Network
MCR	Maximum Continuous Rate
MMI	Man Machine Interface
MIU	Management Information Unit
OPU	Operation Unit
OPC	Optical Convertor
PA fan	Primary Air Fan
PCU	Process Control Unit
PID	Proportional - Integral - Derivative controller
PTF	Pressure -Temperature - Flow meter
PLC	Programmable Logic Controller
RJ-45	Registered Jack
RT time	Real Time
SCADA	Supervisory Control And Data Acquisition
STP	Shield Twisted Per
TCP	Transmission Control Protocol
TDPU	Test DPU
UTP	Unshielded Twice Par
VC	Virtual Control point