

COLLECTION AND INCINERATION OF NON CONDENSABLE GASES (NCG) THROUGH AUTOMATION



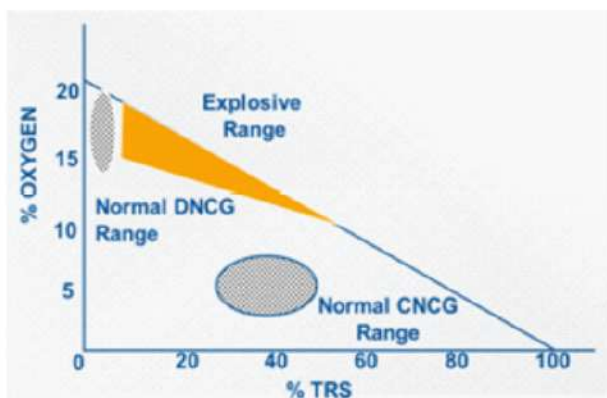
T. Harischandra Prasad



N.V.S.M Krishna

One of the major problems that paper manufacturers face today is to maintain and sustain the optimum performance of Environmental norms without compromising production targets. The most essential components are compliance with Safety and Environment are to be continued to improve hassle free atmosphere in and around the Mill. Air, water, Soil pollutions are not allowed and are to be maintained as per PCB norms and guide lines. While on focusing with Air pollution, one of the challenge is mal-odor which is sometimes beyond control and may lead to public grievances. Hence, which need to be focused and effective controls are in place all the time with less efforts by operators irrespective of their skill and attention is possible through PLC or DCS based automation systems.

The Mal-odor can be controlled through the collection of NCGs, condition and safely transfer NCGs to a location within the mill where they are disposed of by incineration. But NCG's are Toxic, Corrosive and Potentially explosive and thus goal is to maintain the concentration of flammable gases above the upper explosive limits or below explosive limits depends on gas concentrations and volume.



Non-condensable gases, or NCGs, are a by-product of the pulping process and in the distant past these NCGs were largely discharged directly into the atmosphere. Now stringent controls and norms set by pollution control boards and are not allow to discharge these gases into atmosphere. It is

also our social responsibility to safeguard Environment by appropriately incinerating these gases on a safe manner will provide us freedom for production.

Sources of NCG's in Pulp & Paper Industry:

There are Two different types of fugitive NCG's which produces mal-odor emissions from Pulp & Paper industry are non-condensable gas streams of LVHC & HVLC.

Type -1 NCG:Low Volume High Concentration(LVHC) which is also called as CNCG (Concentrated non condensable gases) generated from Blackliquor, Evaporators & its seal pit, NCG transportation foul stream drain systems and Foul condensate main tank.

Type -2 NCG:High Volume Low Concentration (HVLC) which is also called as DNCG (Diluted non condensable gases) generated from digester Chip bin, Pulp blow tank, O2 blow tank, washers, weak Black liquor storage tanks & Brown stock washers during wood cooking & washing stages.

NCGs are formed during cooking and are mostly made up of total reduced sulfur (TRS) compounds such as hydrogen sulfide (H₂S), methyl mercaptan (CH₃SH), dimethyl sulfide (CH₃SCH₃), and dimethyl disulfide (CH₃SSCH₃). These organic sulfides are responsible for the mal-odor associated with pulp mill process.

Volatile organic compounds (VOCs), such as turpentine and methanol are also present to varying degrees in NCGs.

TYPE -1 NCG (LVHC) INCINERATION:

Low Volume High Concentration (LVHC) Non condensable gases are incinerated in Rotary Lime Kiln at 1050 – 1200 deg.C. LVHC NCG from evaporators is passed through heat exchanger, to remove water vapors prior to incineration. Water is used for condensing the vapors and outlet water is routed through Hard piping treatment system. Resulted NCG are transported with the help of Steam Ejector system in which LP steam is used as motive force. Provision is made for removing the condensate formed in the line with the help of condensate tanks and pumping to Hard piping treatment system with level monitoring and control. NCG from Ejector passes through

a droplet separator, heater to raise the temperature to about 110°C to ensure no water entry into kiln and flame arresters are also to be installed at close to both collection and incineration points for safety. NCG is connected to a burner provided just above the Furnace oil burner of lime kiln. The NCG burning system is organized with all necessary safety interlocks. The flame scanner shall monitor the burner flame. Thereby entire NCG (LVHC) is incinerated under thermal oxidation process. The provision must be ensured to incinerate LVHC gases either in Rotary Lime Kilns or alternative incinerate points.

TYPE – 2 NCG(HVLC) INCINERATION:

High Volume Low Concentration (HVLC) Non condensable gases are incinerated in Recovery Boiler. The system consisting of Collection of gases in closed conveyance lines, blowers, scrubber, spray tower, droplet separator and heater. Gases conveyed to recovery boiler by using blower and is mixing with tertiary air and is incinerated at 1050 – 1200°C. Thereby entire NCG (HVLC) is Incinerated under thermal oxidation process.

FOUL STREAM HARD PIPING:

Foul streams are the major smell emitting waste waters generated from evaporator condensates, evaporator vacuum system seal water, LVHC systems water droplets, LVHC condensate, HVLC system water and HVLC condensates. Formerly all these streams were discharging into open drains to pass to ETP and thus lot of fugitive odor was dominant. IPAPPM installed and commissioned “Hard piping System” to eliminate fugitive odor.

THE SYSTEMS CONSIST OF:

- SS Collection pots and pumping system at various location to collect foul streams
- Closed Conveyance system for Collection of various foul streams to common tank
- Common Storage tank for all foul stream collections
- Auto Valves and Pumps with Logic control system
- Heat Exchanger to reduce temperature
- Pumping and conveyance lines (SS) to ETP Aeration Tank

Foul streams are collected individually at various sources in dedicated SS Pots. From there, it is pumped to Common Storage tank of suitable capacity. The storage tank is completely closed and the vent fugitive gases if any are connected to LVHC System for incineration. These foul streams are pumped to Heat Exchanger to reduce temperature impact and followed by online Hydrogen Peroxide dosing to oxidize odorous compounds. From where, these treated streams are routed to ETP aeration tank and immersed into the bottom of the tank in order to further eliminate odor & to oxidize with available oxygen.

HARD PIPING SYSTEM FOR FOUL STREAM:

Hard piping system for treatment of foul streams have been installed. H₂O₂ auto dosing system is added to reduce foul condensate toxicity and further neutralize the ill effect and thereby reduction of air demand in aeration tanks. All the systems and controls are in operation up to the expectations.

LVHC NCG SYSTEM UPGRADATION AND MODERNIZATION WITH AUTOMATION CONTROLS:

Major activities consist installation of new (higher cap.) Steam Ejector, renewal / new piping to carry LVHC. Instrumentation for better operational controls and Safety devices with interlocks and connected mechanical & civil works. Burner Management system (BMS) for both kilns for safety compliance.

- NCG from Ejector passes through a droplet separator, heater to raise the temperature to about 110°C to ensure no water entry into kiln and flame arresters installed close to both collection and incineration points for safety.
- NCG is connected to a burner provided just above the Furnace oil burner of lime kiln.
- The NCG burning system is provided with all safety interlocks. The flame scanner shall monitor the burner flame continuously. Thereby entire NCG (LVHC) is incinerated under thermal oxidation process.
- Provision has been provided to incinerate LVHC gas either in RLK# 1 or RLK#2 (one at a time)
- The total collection and incineration of LVHC is fully automated programmed with necessary safety interlocks and operation of plant is as simple by pressing the “COLLECT” and “BURN” Soft push buttons on the HMI screen.
- Collection of NCGs is provided as per the Operational requirement by Selecting the required collection of NCG points.
- After selecting the required sources press the Button “COLLECT” it will check all the interlock healthiness conditions and collects the LVHC gases through ejector and vents at the Ejector outlet. If any of the interlock condition is not satisfied the collection will stop and highlights the unsatisfied conditions as an operator alert
- Similarly select the kiln where LVHC has to be incinerated and press “BURN” push button as per the logic it checks the healthiness of the kiln and other logics closes the vent valves and opens the double block valves as provided for incineration of the LVHC gases.

SYSTEM DESIGN ARRANGEMENTS:

- An interlock Logic system coupled with a mechanical fail safe designs
- An alarm system is programmed to warn the operators of any abnormal process condition.
- An automatic emergency vent is located at higher elevation prior to the NCG incineration point.
- A rupture disc for protection from over-pressurizing the system is installed prior to the incineration point.
- A rupture disc is located near the bottom of a long vertical rise in the NCG piping.

LVHC COLLECT PERMISSIVE INTERLOCKS & LOGICS

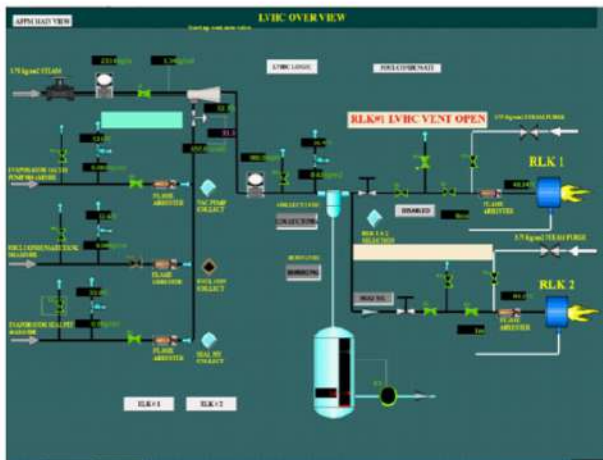
- LVHC Gas flow above 350 Nm³/Hr.
- Ejector Inlet Steam pressure above 2.5 Kg/cm²
- All Collection sources rupture disc inlet pressure below 0.5 Kg/cm²
- Foul condensate tank rupture disc inlet pressure above -0.25 Kg/cm²

LVHC FIRING IN KILN INTERLOCKS & LOGICS

- MAIN FLAME “ON” SIGNAL OF THE KILN
- BURNING ZONE Temperature greater than or equal to 750°C
- LVHC Temp at Kiln less than 190°C
- Condensate Pot Level below 90%
- LVHC Gas flow above 350 Nm³/Hr
- Ejector Inlet Steam above 2.5 Kg/cm²



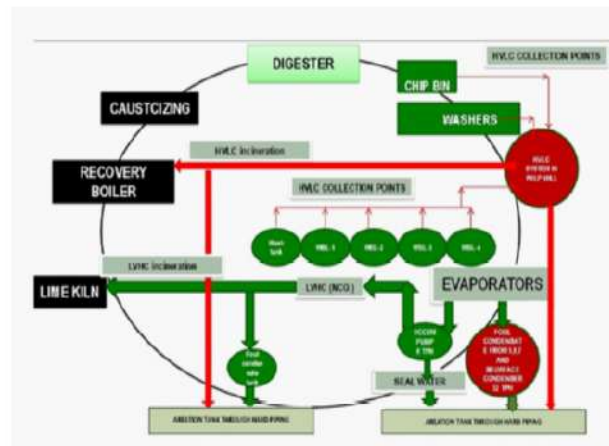
LVHC Gas inlet Pipe line at Lime Kiln for incineration



LVHC System Graphic Screen shot

LVHC NCG SYSTEM UPGRADATION AND MODERNIZATION WITH ADVANCED TECHNOLOGIES:

Major activities consist of Installation of new Black Liquor Cooler; Exiting WBL re-boiler repairs / maintenance; Installation of New HVLC Gas Cooler, process engineering and its related piping; Instrumentation for better and consistent operational controls; Safety devices / interlocks and connected mechanical & civil works. Connecting WBL (weak black liquor) storage tanks vent to HVLC incineration system.



HVLC COLLECT PERMISSIVE LOGICS & INTERLOCKS

EVAPORATOR SOURCE

- Source pressure above - 230 mmwc
- Gas Temperature at cooler outlet below 55 °C
- Recovery Boiler is in firing position
- Source blower RPM above 500
- Rupture disc pressure at RB4 below 0.21 Kg/cm²

FIBRE LINE SOURCE

- Rupture disc pressure at RB4 below 0.21 Kg/cm²
- Source blower RPM above 500
- Source gas temperature below 55 °C

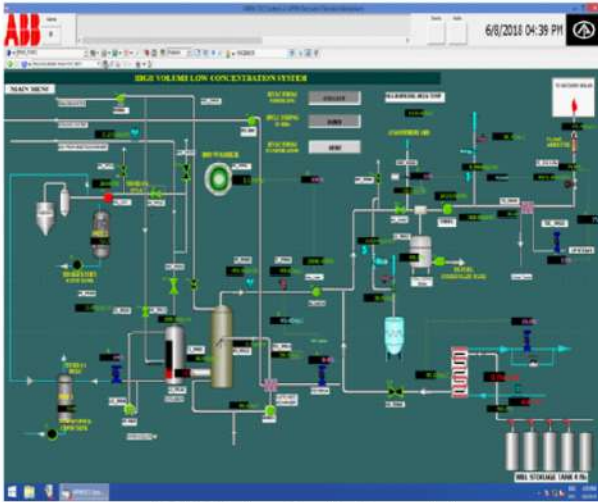
HVLC FIRING INTO RECOVERY BOILER LOGICS & INTERLOCKS

- Recovery Boiler in running condition
- Recovery Boiler HVLC Blower above 500 rpm
- HVLC gas flow above 2500 Nm³/Hr.
- HVLC gas pressure in between 50 mmwc to 500 mmwc
- HVLC Temperature in between 65 °C to 190 °C
- Rupture disc pressure at RB4 below 0.21 Kg/cm²

HVLC OPERATION

- The total collection and incineration of HVLC is fully automated and programed with necessary safety interlocks and operation of plant is as simple by pressing the “COLLECT” and “BURN” Soft push buttons on the screen
- There are two collection sources and one incineration point
- By Pressing the Button “COLLECT” it will check all the interlock healthiness conditions and collects the HVLC gases from respective source . If any of the interlock condition is not satisfied the collection will stop and highlights the unsatisfied conditions
- The HVLC gases are collected and passed through blowers and send to recovery boiler for incineration.

- The logic Interlocks to be satisfied healthy for burning the HVLC and then press the “BURN” It opens the shut off valve and closes the vent valve allowing the HVLC gases incinerate to Recovery Boiler



HVLC System Graphic Screen shot

BENEFITS OF NCG COLLECTION AND INCINERATION THROUGH AUTOMATION:

- Environmental Compliance
- Enhancement of Human & Equipment Safety
- Elimination of mal-odor in the vicinity
- Freedom for achieving Production targets
- Dependency reduce on operator skill and alertness
- Optimization of multiple activities involvement in various locations through automation

Some of the photographs of the system:

Black Liquor Cooler

HVLC Gas Cooler



Hard Piping System – Foul Streams Main Collection Tank



Hard Piping System – Heat Exchanger



Hard Piping System – HVLC, LVHC POTS



H₂O₂ Dosing & Hard Piping System – To Aeration Tank

