BLEACH SCRUBBER SURVEY

Review of Past Surveys / Format of New Survey

Report to Bleaching Committee
Fall 2016

Jim Collins – October 25, 2016

Bleach Scrubber Survey Review

- ✓ **Review of Past Scrubber Surveys**
  - **Spring 1989 Scrubber Survey – by Trevor Tenn**
  - Survey was to include:
    - Federal, provincial and other regulations for Cl_2, ClO_2 emissions from the bleach plant
    - Processes used for absorption
    - Removal efficiencies achieved, versus targets
    - Materials of construction
    - New process solutions developed by mills
    - Problems encountered that still need solutions

Bleach Scrubber Survey

- ✓ **Spring 1989 Scrubber Survey Sections**
  - Part I – General
    - Mill / Chemical Charges
  - Part II – Federal / Provincial / Others Regulations
  - Part III – Cl_2, ClO_2 Absorption Processes in Mill
    - Gases to Scrubber (Properties)
    - Liquids to Scrubber / Liquid from Scrubber (Properties)
    - Scrubbing Efficiency
  - Part IV – Mechanical Details – Tower, Packing, Materials, Fans, Pumps, Problems, Solutions, etc.

Bleach Scrubber Survey

✓ Spring 1989 Survey

- At the time of this survey, any surveys were sent out by CPPA Technical Section to the member companies (pre-internet / e-mail)
- Surveys conducted by the Bleaching Committee during 1991/92

✓ Fall 1993 Survey Paper

- Work continued on this survey by committee members through 1993 when a paper was developed by Dennis Owen and presented at the CPPA Annual Meeting? Published?
  - Paper: Bleach Plant Scrubber Survey by Dennis Owen, Mark Owen and Larry Merriman – Date 1993?

Bleach Scrubber Survey

- ✓ **Fall 1993 Bleach Plant Scrubber Survey Paper**
  - **Highlights:**
    - 42 mills surveyed
    - 29 mills participated in the survey from coast to coast
    - Scrubbers reported were 18 packed tower and 7 cross flow (Waterloo Turbotac)
    - Paper included the chemistry, stoichiometry and costs of the various scrubbing media
    - Major Problems – Tower Corrosion, Tower Wear, Packing, Coating, Precipitation, Clogging, Channelling, FRP Delamination.
    - Solutions – Packing: Replace with New, Packing: Wash and Re-use, Tower: Replace or Reline, Internals: Internals: Replace with new materials, Install Strainers in the Scrubbing Liquor

Bleach Scrubber Survey

- ✓ **Fall 1993 Bleach Plant Scrubber Survey Paper**
  - **Conclusions:**
    - Significant benefit in understanding the source, volume & concentrations of the gaseous emissions
    - Need to understand cause of variation in reductant and caustic residual in the scrubbing media for surge flows
    - Strong justification for installing filters in scrubbing medium feeds and/or understanding why the precipitates are formed
    - Obvious room for locating reliable ORP and pH systems
    - Need means to have rapid response to excessive emissions to scrubber (alarms, alkali/reducing agent flow response)

Bleach Scrubber Survey

- **Fall 1999 Bleach Scrubber Survey:**
  - Update of the 1993 survey was sent out to the committee members at the start of 1998? This was headed by Dennis Owen – 38 mills surveyed
  - Survey was completed during summer 1999 and results presented at Fall 1999 Meeting by Dennis Owen

Bleach Scrubber Survey

- ✓ **Fall 1999 Bleach Scrubber Survey**
  - **Highlights (1):**
    - 38 mills surveyed
    - Performance of 37 scrubbers reported:
      - 26 packed scrubbing tower
      - 11 cross flow scrubbers (Waterloo Turbotac?)
    - **Emissions:**
      - With tower residuals having reduced since previous report, bleaching efficiency has improved leading to reduced Cl_2 and ClO_2 to the scrubber

Bleach Scrubber Survey

- ✓ **Fall 1999 Bleach Scrubber Survey**
  - **Highlights (2):**
    - **Packing:**
      - Type of packing used has shifted to a structured type of packing (Tray, Tellerettes, Heilex, Interlox, Tri-pack, Snowflake)
    - **Packing Material of Construction:**
      - Materials of construction have shifted to more corrosion resistant packing (CPVC, Kynar, Polypropylene, Ceramic)
    - **Scrubbing Efficiency:**
      - Efficiency of scrubbing is still rather poor.
        - » Chlorine: 45% to 100%, majority <80%
        - » Chlorine Dioxide: 46% to 100%

Bleach Scrubber Survey

- ✓ **Fall 1999 Bleach Scrubber Survey**
  - **Highlights (3):**
    - Although the use of Eop Filtrate is the predominate scrubbing liquor, there was a shift to use of more effective scrubbing liquors – White Liquor / Weak Wash / SO_2
    - Some less effective scrubbing liquors have been reinforced with alkali or reducing agent
    - **Scrubbing Liquor Used in order of preference:**
      - Eop Filtrate / White Liquor / Weak Wash / Caustic Soda / SO_2 / Eop plus White Liquor / Eop plus NaOH / Water plus SO_2 / Water plus Peroxide

Bleach Scrubber Survey

- ✓ **Fall 1999 Bleach Scrubber Survey**
  - **Highlights (4):**
    - **Control of Bleach Plant Scrubbers:**
      - More mills are trying to control the effectiveness of their scrubber by the use of
        - » ORP and pH Control
        - » Chlorine Dioxide analyser (3 mills) – more exploring that option
        - » Installing Filter / Screens in recirculating liquor to reduce the tendency of plugged packing (e.g. high fibre in Eop Filtrate and high suspended solids in white liquor)

Bleach Scrubber Survey

- ✓ **Fall 1999 Bleach Scrubber Survey**
  - **Highlights (5):**
    - **Problems:**
      - Coating and precipitation of fibre or solids on the packing is still a significant problem. It calls for periodic acid washing and / or removal and cleaning of the packing.
    - **Scrubbing Problems order of seriousness:**
      - Clogged Packing / Packing Coating / Packing Precipitation (Fibre / Solids) / Packing Corrosion / Fan / FRP delamination / Metal corrosion / Tower Corrosion / Tower Wear / Nozzle Plugging / Demister / Entrainment

Bleach Scrubber Survey

- ✓ **Fall 1999 Bleach Scrubber Survey**
  - **Highlights (6):**
    - **Solutions to Scrubber Problems:**
      - New Packing / Wash & Reuse Packing / Replace Material / Replace Tower / Acid Wash / Replace Internals / Other Solutions / Install Second Demister

New 2016 Bleach Scrubber Survey

- **SURVEY PURPOSE:**
  - To determine the state of the art of Bleach Plant Air Emission Scrubbers presently installed in member company mills and non-member mills in Canada (excluding ClO_2 generator plant tail gas scrubber)
  - To update information from the previous surveys, conducted in 1998-9 and 1989, and paper published in 1993

New 2016 Bleach Scrubber Survey

- **The survey will include:**
  - Federal, provincial, state and other regulations for Cl_2, ClO_2, **$CHCl_3$** emissions from the bleach plant
  - Processes used for absorption
  - Removal efficiencies achieved, versus targets
  - Materials of Construction
  - New process solutions developed by mills
  - Problems encountered that still need solutions

New 2016 Bleach Scrubber Survey

✓ Part I – GENERAL:

- Mill Name, Mill Contact, Location, Telephone No., E-mail address
- Mill Company and Location will be coded

- Number of Bleach Plants at Mill:
- Bleaching Sequence (s):
- O_2 Delignification: Yes / No
- Tonnage / Bleach Plant:
- Target Brightness:
- Wood Species: (Hardwood, Softwood)

New 2016 Bleach Scrubber Survey

✓ Part I – GENERAL (2):

- **CHEMICAL CHARGES (kg/ADMT)** (by Bleach Plant)
  - Kappa Number into Bleach Plant /O_2 Delignification (in & out)
  - O_2 Delignification Stage (Yes / No)
  - D_0 Stage – ClO_2, tower/vat residual, pH, temperature
  - Pc Stage – NaOH, pH, temperature
  - E_1 Stage – NaOH, O_2, H_2O_2, etc., pH, temperature, Kappa #, Brite
  - D_1 Stage – ClO_2, NaOH, tower/vat residual, pH, temperature, Brightness
  - E_2 Stage – NaOH, H_2O_2, Other, pH, temperature
  - D_2 Stage – ClO_2, NaOH, tower/vat residual, pH, temperature, Brightness
  - H Stage – Cl_2, tower/vat residual

New 2016 Bleach Scrubber Survey

- **Part II – Government Regulations regarding Bleach Plant Emissions:**
  - Federal Regulations (Canada) – Cl_2, ClO_2, **$CHCl_3$**, **Other**
  - Federal Regulations (USA) – Cl_2, ClO_2, **$CHCl_3$**, **Other**
  - Provincial Regulations (Canada) – Cl_2, ClO_2, **$CHCl_3$**, **Other**
  - State Regulations (USA) – Cl_2, ClO_2, **$CHCl_3$**, **Other**
  - Other Regulations – Cl_2, ClO_2, **$CHCl_3$**, **Other**

New 2016 Bleach Scrubber Survey

✓ Part III – Mill Cl_2, ClO_2 Absorption Processes:

- Identify if packed tower or cross flow scrubber (Waterloo / Teller)
- Use a water "pre-absorber" to treat gases from Seal Tanks, Towers prior to Bleach Scrubber?

- **A. Gases to Scrubber** (Temperature, ACFM, kg/d: Cl_2 / ClO_2 / $CHCl_3$)
  - Flow rates (Tower, Washer, Seal Pit) – all stages
  - Flow rates (Total) – give total if breakdown unknown
  - Temperature
  - Content:
    - Total Cl_2 kg/d
    - Total ClO_2 kg/d
    - Total $CHCl_3$ kg/d

New 2016 Bleach Scrubber Survey

- ✓ **Part III – Mill Cl_2, ClO_2 Absorption Processes:**
  - **B. Gases from Scrubber Stack** (Temperature, ACFM, kg/d: Cl_2 / ClO_2 / $CHCl_3$)
    - Flow rates (Stack)
    - Temperature
    - Content:
      - Total Cl_2 kg/d
      - Total ClO_2 kg/d
      - Total $CHCl_3$ kg/d
  - **C. Scrubbing Efficiency:**
    - Cl_2 Target: Actual:
    - ClO_2 Target: Actual:
    - $CHCl_3$ Target: Actual:

New 2016 Bleach Scrubber Survey

✓ Part III – Mill Cl_2, ClO_2 Absorption Processes:

- **D. Liquid to Scrubber:**
  - **Source** (E_1 filtrate, E_2 filtrate, White Liquor, Weak Wash, Dilute Caustic, Green Liquor, Mixtures (identify), secret snake oil, other)
  - Make-up Flow
  - pH
  - Temperature
  - Recirculation or once-through
  - Solids/Fibre in Suspension (ppm)
  - Pre-Treatment: e.g. filter, caustic addition to set pH, other

New 2016 Bleach Scrubber Survey

- ✓ **Part III – Mill Cl_2, ClO_2 Absorption Processes:**
  - **E. Liquid from Scrubber:**
    - Flow
    - pH
    - Temperature
    - Disposal to ???
    - Recirculate?

New 2016 Bleach Scrubber Survey

- ✓ **Part III – Mill Cl_2, ClO_2 Absorption Processes:**
  - **F. Control of Bleach Scrubbers:**
    - ORP Control
    - pH Control
    - Control of Reducing Agent and Caustic Addition
    - ClO_2 Analyser
    - Recirculation of Scrubbing Liquor
  - **G. Process Problems:**
    - Control:
    - Efficiency:

New 2016 Bleach Scrubber Survey

✓ Part IV – Mechanical Details:

- Complete For Each Bleach Plant Scrubber

– A. Tower:

- Diameter
- Material

– B. Packing:

- **Type:** (Tri-Pack, Tray, Tellerettes, Heilex, Interlox, Snowflake, other)
- **Material:** (Ceramic, PVC, CPVC, Polypropylene, Kynar, other)
- **Size:** (2 inch, 3 inch, other)
- Height
- Pressure Drop
- Scrubbing Liquor Flow of Packing

New 2016 Bleach Scrubber Survey

- ✓ **Part IV – Mechanical Details:**
  - **C. Support Plate:**
    - Type
    - Material
  - **D. Hold-down Plate Type:**
    - Type
    - Material
  - **E. Spray Nozzles:**
    - Type
    - Material
  - **F. Spray Nozzles / Demister:**
    - Type
    - Material

New 2016 Bleach Scrubber Survey

✓ Part IV – Mechanical Details:

– G. Describe Problems:

- **Tower:** – Corrosion Wear Channelling
- **Packing:** – Coating Precipitation Clogging
- **FRP/Resin:** – Separation Leaching Other
- **Materials:** – FRP Resin Delamination
- **Metals:** – Corrosion Other

– H. Solutions:

- **Tower:** – Replace Tower Replace Material Reline
- **Packing:** – Replace with New, Wash and Re-Use, Acid Wash
- **Internals:** – Replace with Better Materials, 2nd Demister
- **Strainers:** – Install Strainers in the Scrubbing Liquor

New 2016 Bleach Scrubber Survey

✓ Part IV – Mechanical Details:

- **I. Fan (s):**
  - **Make:** – Type (FD / ID) Model No. Year Installed
  - Rated Capacity
  - Differential Pressure
  - Speed
  - **Material:** – Housing Impeller Shaft
  - **Motor:** – Hp
  - **Problems:** – Chemical Corrosion

New 2016 Bleach Scrubber Survey

✓ Part IV – Mechanical Details:

- **J. Pump (s):**
  - **Make:** – Model No. Year Installed
  - Rated Capacity (gpm)
  - **Material:** – Housing Impeller Shaft
  - **Motor:** – Hp
  - Problems: – Chemical Corrosion Packing Mechanical Seal

- **K. Other?**

Other Suggestions