GUIDELINES FOR

CONDUCTING A

MERCURY BALANCE

May 1999

AN INTERNAL GUIDANCE DOCUMENT

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1. INTRODUCTION

1.1 PURPOSE

The Mercury Balance Task Group has prepared these voluntary guidelines for producers who wish to conduct a balance to account for mercury use in the mercury cell operation. As used in this guidance document, a mercury balance is an accounting of mercury that enters and leaves a system (a chlor-alkali facility) during a specified time.

The task group prepared this document for the following reasons:

The industry and the Chlorine Institute are committed to the principles of Responsible Care™. The Chlor-Alkali industry is responsible and accountable for the safe use of mercury in our plants and the safe use of our products. While we believe the release of mercury from the chlor-alkali industry is a very low percentage of anthropogenic and natural releases of mercury to the environment, our vision and objective is to ensure our actions do not cause harm to human health or the environment and to surpass environmental standards now and in the future. The Institute's Board of Directors has approved measures to monitor the progress towards reduction of mercury use by the industry and has specifically requested the Mercury Balance Task Group to insure these measures are adequately defined.

Conducting periodic mercury balances is one method to better understand mercury use and releases. The document does not describe reduction methods but may help the plant to target where reduction is most beneficial. Plants that utilize this information and follow these guidelines will have consistency in approaches to the balance and the data reported will be on the same basis.

1.2 RESPONSIBLE CARE

The Institute is a Chemical Manufacturers Association (CMA) Responsible Care® Partnership Association. In this capacity, the Institute is committed to: Fostering the adoption by its members of the Codes of Management Practices; facilitating their implementation; and encouraging members to join the Responsible Care® initiative directly.

Chlorine Institute members who are not CMA members are encouraged to follow the elements of similar responsible care programs through other associations such as the National Association of Chemical Distributors' (NACD) Responsible Distribution Program or the Canadian Chemical Manufacturers Association's Responsible Care® program.

1.3 DISCLAIMER

The information in this guidance document is drawn from sources believed to be reliable. The Institute and its members, jointly and severally, make no guarantee, and assume no liability, in connection with any of this information. Moreover, it should not be assumed that every acceptable procedure is included, or that special circumstances may not warrant modified or additional procedures. The user should be aware that changing technology or regulations may require a change in the recommendations herein. Appropriate steps should be taken to assure that the information is current. These suggestions should not be confused with federal, state, provincial, or municipal regulations nor with national safety codes or insurance requirements.

1.4 APPROVAL

The Board Committee on Mercury Issues approved this guidance document on May 13, 1999.

1.5 REVISIONS

Suggestions for revisions should be directed to the Secretary of the Institute.

1.6 REPRODUCTION

2. MERCURY BALANCE PHILOSOPHY

Prior to conducting a mercury balance, the facility needs to understand what is required to make the undertaking successful. While there can be a variety of approaches to the balance, we believe there are three key ingredients that lead to any successful approach. These are commitment, time, and resources.

Total Commitment

A successful mercury balance requires commitment from people at all levels. A mercury balance requires a unified approach in the way mercury is viewed and treated in the plant. It may include but is not limited to purchasing, stores inventory, process use, identification of point sources, emissions, accumulation areas, identification of measurement points, conducting mercury inventory and mercury balance, analyzing samples, calculating and interpreting results, and troubleshooting mercury losses in the process.

Time

A balance is a snap shot based on years of data. A successful balance program requires ongoing sampling, repeated inspections, and detailed record keeping.

Resources

Sufficient resources should be allotted for mercury accounting and cell inventory purposes. Depending on the complexity of the facility, a dedicated person may be needed to coordinate the balance activities. Alternatively, the facility may use a “Mercury Balance Team” to coordinate the balance as well as reduction efforts. The team may include cross-functional disciplines including but not limited to the following:

- Site Coordinator-Team Leader
- Production Engineering
- Plant Operator

- Process Engineering
- Process Technology
- Analytical
- Responsible Care Representative
- Plant Hygienist
- Safety Engineer
- Plant Management

The balance can be useful toward reducing mercury use. The approach to the identification of losses and reduction of mercury use should include the following:

- Reliable Measurement Techniques
- Representative Sampling
- Process Surveys to identify losses
- Prioritization of areas for improvement
- Defining and implementation of removal technologies

3. COMMUNICATION STRATEGY

Communication is a cornerstone of a successful Mercury Balance. It provides the continuity to many moving pieces of the balance. **Informed people are more willing to participate cooperatively.**

A communication strategy should consider a broad audience which may include facility personnel, division and/or corporate staff, immediate community around the plant site, and environmental regulators. Implementation of the strategy should begin within the facility and be well established before expanding to external audiences.

The communication strategy should be defined and "championed" by the mercury balance team or coordinator. It may be more effective to have a separate communications team if the scope of the balance work and mercury reduction program is large.

Some companies have developed a formal "Communications Blueprint" which is especially effective in the launch phase of mercury balance and reduction programs. Appendix 9.1 provides an example of a communication blueprint.

4. RESPONSIBILITIES AND EXPECTATIONS

Because of the magnitude of the task and the number of variables involved it is desirable to have involvement from as many employees as possible. Everyone connected to the operation is responsible, to some extent, for the success of the mercury balance.

Awareness is key to the involvement of employees. Keeping people informed will help keep them involved. Many ideas and suggestions are generated outside the mercury balance team (or

coordinator). A mechanism should be in place to insure proper evaluation of all such ideas and suggestions.

Spreading out the responsibilities will also help keep people involved. Analyze the long and short term goals and assign specific tasks or action items needed to accomplish the short term goals. Set dates when the person(s) are expected to complete the items and stick to the dates. The action items as well as the short term goals should be specific and attainable. This may require periodic reassessment of priorities and short term goals.

The team leader should be a good motivator and keep the team focused by clearly stating responsibilities and expectations. Keeping a log of meeting minutes and action items can help facilitate an organized approach to the task. If the team is held accountable to well specified tasks and can readily see results then progress toward the long term goal(s) will continue.

Tracking progress is a useful tool. Keeping management and other personnel in the facility informed about how the group is advancing is important.

5. GOALS AND OBJECTIVES

It is essential to have a plan or strategy to construct a successful mercury balance. Achieving a successful mercury balance will take time. It is important to have long term goals (e.g., achieving a 100% accountable mercury balance), but it is also important to determine short term goals. A mass balance of this magnitude is not simply solved, but evolves. A key component of a successful mercury material balance is to outline goals and objectives and anticipate what is needed to reach those goals.

Although approaches will differ with the specific challenges of each site, there are four basic steps to outlining a mercury balance strategy. These are as follows:

1. List the Mercury Balance "Streams"

Establish the boundary of the system for the mass balance. Then assess operations within that boundary to determine how mercury enters the system, where it is contained in the system, where it is accumulating in the system and where mercury can escape the system. This assessment can be done by an individual who is knowledgeable of plant operations or by a diverse group knowledgeable of different aspects of the operation.

2. Determine the Known Variables

Determine what is known about each of the items on the above list. Do you have a mass value for the item? How accurate is the value? Is it a measured or estimated value? Is it supported by analyses? What is the relative size of the value? How accurate does it need to be? For example, when evaluating the hydrogen by product one might determine:

- The mass rate of the hydrogen is a measured value by an accurate flowmeter in ft^3/min.

- The mercury concentration in the hydrogen (mg/m^3) is determined monthly by an accurate test method.
- Hydrogen accounts for a significant amount of mercury leaving the system.
- It is important to be precise when determining hydrogen emissions for the mass balance.

On the other hand if you are trying to determine how much mercury leaves the system through fugitive emissions from brine clarifiers:

- The mass rate of the fumes is an estimated value in ft^3/day.
- The concentration of mercury in the fumes (mg/m^3) is determined once a year (e.g., by using an instrument such as Jerome meter).
- These fugitives account for a very small portion of mercury leaving the system.
- It is not as important to be accurate when determining these fugitive emissions for the mass balance.

3. Prioritize

Prioritize the "streams" or variables into categories. Criteria for prioritization will vary but may include the following:

- Impact on balance (largest values may have higher priority)
- Ease of data collection (some streams may be easily measured or analyzed)
- Cost (some items may be very high cost and have minimal impact on balance).

4. Set Goals

Set appropriate long and short term goals. This should be done by the entire team if appropriate. The process of achieving the long term goals may take several years. It is important to set realistic, achievable short term goals to keep focused. Short term goals should lead directly to the long term goals.

6. DIFFERENT APPROACHES

When performing a mercury balance it is important to choose the appropriate time frame to collect data. Some data can be readily obtained on a daily or weekly basis while other data can only be obtained when equipment can be made available. Some data can only be obtained once or twice a year. Some data may need to be obtained even less frequently if shown to be relatively constant and have little impact on the overall balance.

It is useful to convert all of the data to the same basis. For example, loss of mercury to the hydrogen system might be measured in pounds per week while loss to the product sodium hydroxide might be measured in grams per ton. Converting all data to the same basis will help compare relative sizes of the "streams" and help reduce errors in bookkeeping.

It is also important to choose the time frame over which the balance is performed. Establishing a basis for the data will help keep this time period flexible. Three typical time frames are monthly, semi-annually, and annually. Individual facilities need to decide the frequency for conducting mercury balances which will best meet their needs.

Monthly Balance

This type of balance may be useful as an early indicator of balance problems. Each inventory and use category is calculated except for the cell inventory. The mass balance calculations are performed and any unaccounted use is reflected in the unknown cell inventory or as a difference to balance. The cell inventory value becoming unrealistic or the difference to balance becoming large indicates an area for further investigation.

Semi-Annual Balance

When performed, this type of balance can be used to accelerate the learning process. After the mercury balance is established, the semi-annual may not be needed. This type of balance should coincide with a measurement of the cell inventory. The mass balance calculations are performed and, if all mercury is accounted for correctly, the accountability will be near 100%.

Annual Balance

An annual balance should coincide with the measurement of the cell inventory. It is essentially the same as a semi-annual balance and can be used a good marker of progress towards a complete mercury balance.

7. MERCURY BALANCE COMPONENTS

A mercury balance is an accounting of mercury entering and leaving a system during a specified