08Jul75

Letter sent to the following:

Earl M. Morgan, Badin Works
G. D. Hicks, Massena Works
R. E. Podhora, Pt. Comfort Works
A. G. Clayton, Rockdale Works
J. C. Vergho, Tennessee Operations
L. L. Haisch, Vancouver Works
J. A. Thompson, Wenatchee Works
R. L. Parsons, Warrick Operations

PLAINTIFF'S EXHIBIT
tabbies
AL-662

FROM T. B. BONNEY

PITTSBURGH OFFICE

TO SMELTING PLANT INDUSTRIAL HYGIENISTS

CONFIDENTIAL

July 7, 1975

RE: CHARACTERIZATION OF EMPLOYEE EXPOSURES IN POTROOMS AND ELECTRODE PLANTS

As many of you already know, the Aluminum Association has contracted with Tabershaw-Cooper Associates to conduct a mortality study of the Aluminum Industry. The purpose of this study is to determine if there is an increased mortality in the smelting and electrode plant populations and, if there is, to suggest the cause. Government agencies imply that, in view of the exposures that these employees receive, they are under increased risk. Although we have not seen evidence of this, we presently do not have incontrovertible evidence to prove our point - hence the mortality study.

In connection with this study, we think it imperative that we have an accurate and relatively comprehensive characterization of employee exposures throughout our potrooms and electrode plants. Regardless of the outcome of the epidemiological study, the characterization will be of much value to us. Should the results of the study prove negative, we will have a good basis for saying that, at least in a general sense, the present employee exposures are not excessive (realizing, of course, that past exposures may have been greater). On the other hand, should the study show that some of our employees are subjected to increased risks, a characterization of the environment may be useful in determining causative agents and providing a baseline of concentration levels, some of which may have to be reduced.

We ask your assistance in collecting the necessary data. Since we are interested primarily in employee exposures, the bulk of the work will involve personal samplers. By confining the potroom study population to potmen and anodemen, we can limit the total work load without significant loss of needed data. Likewise, the electrode plant population to be studied can also be limited. Two or three occupations in the carbon or paste plants should be chosen for study; primarily those who are exposed to hydrocarbons (e.g., mixers, pressmen, potliners, etc.). In the carbon plants the baking furnace area should also be included (e.g. packer - unpacker). The scheme for characterization of the environments is attached as well as information about sampling and analysis.

The greatest depth of data will be in determining exposures to fluorides, hydrocarbons ("coal tar pitch volatiles") and nuisance dusts. Information on carbon monoxide and sulfur dioxide need only be of sufficient depth to show the range of exposures and, we trust, to demonstrate that the concentrations of these contaminants are not sufficiently high to present a problem. Any current evaluations that you already have on hand can be used in lieu of collecting new data. To be of use in connection with the mortality study, your environmental characterization data must be in our hands by June 1, 1976.

Should you have any questions about the sampling and analysis, or if you require any sampling or analytical assistance from us, please contact George Farrah or myself.

T. B. BONNEY

TBB:lms

Enclosures: I. Summary Table
II. General Information - Sampling & Analysis
III. Fluoride Sampling Method

cc:
G. H. Farrah/J. M. Plunkett - Alcoa Technical Center
M. O. Colwell/B. D. Dinman - Pittsburgh

APPE IX I

SUMMARY TABLE

CHARACTERIZATION OF EMPLOYEE EXPOSURES IN POTROOMS AND ELECTRODE PLANTS

Sample Group	No. Samples	Sampling Method	Collection Media	Analysis for	Analytical Method
PREBAKE POTROOMS					
P1	20	Respirable Sampler plus Filter	Membrane Filter	Respirable Dust	Gravimetric
P2	20	Filter	a) Membrane Filter	a-1) Dust	Gravimetric
				a-2) Partic. F	Spec. ion el.
			b) Alkaline Cellulose Pad	b-1) Gaseous F	Spec. ion el.
				b-2) SO_2	Gravimetric
P3	5	a) Ecolyzer or b) Detector Tubes	a) Plastic Bag b) Silica Gel	a) CO b) CO	Direct Readout Stain Length
SODERBERG POTROOMS					
S1	20	Respirable Sampler plus Filter	Glass Fiber Filter	a) Respirable Dust	Gravimetric
				b-1) Benz. Soluble	Gravimetric
				b-2) PPOM	CG
S2	20	Filter	a) Membrane Filter	a-1) Total Dust	Gravimetric
				a-2) Partic. F	Spec. ion el.
			b) Alkaline Cellulose	b-1) Gaseous F	Spec. ion el.
				b-2) SO_2	Gravimetric
S3	20	Filter, Adsorption	a) Glass Fiber Filter	a-1) Total Dust	Gravimetric
				a-2) Benzene Sol.	Gravimetric
				a-3) PPOM	GC
			b) Activated Carbon	b) PPOM	GC

SUMMARY TABLE

CHARACTERIZATION OF EMPLOYEE EXPOSURES IN POTROOMS AND ELECTRODE PLANTS

Sample Group	No. Samples	Sampling Method	Collection Media	Analysis for	Analytical Method
S4	5	a) Ecolyzer or b) Detector Tubes	a) Plastic Bag b) Silica Gel	CO CO	Direct Readout Stain Length
ELECTRODE PLANTS					
E1	10	Respirable Sampler plus Filter	Glass Fiber Filter	a) Respirable Dust b-1) Benzene Soluble b-2) PPOM	Gravimetric Gravimetric GC
E2	10	Filter plus Adsorption Tube	a) Glass Fiber Filter b) Activated Carbon	a-1) Total Dust a-2) Benzene Soluble a-3) PPOM b) PPOM	Gravimetric Gravimetric GC GC

NOTES:

A. Potrooms: Personal samples collected in potrooms shall be equally divided among potmen and anode men.

B. Electrode Plants: Personal samples in this group shall represent exposures to electrode plant or potlining personnel. Job classifications selected for evaluation shall primarily be those who are subjected to substantial exposures of "coal tar pitch volatiles," (e.g. mixer operators, pressmen, potliners, etc.). Carbon plant evaluations shall also include a few evaluations of those in the baking furnace area (e.g. packer, unpacker).

C. All sampling durations as near to eight hours as possible.

APPENDIX II

Characterization of Employee Exposures in Potrooms and Electrode Plants

General Information: Sampling and Analysis

A. Equipment

1. Personal Monitor Pump. Useful sampling rate is about 1.5 to 2.8 lpm. Minimum operating time per battery charge should be 8 hours. Preferably, these pumps should have pulsation dampeners, voltage regulators, and flow indicators (rotometers).

   Pumps which we have found to be satisfactory are:

   *a. MSA Model G, Portable Pump, with battery charger, Cat. No. 456252 — $231.00

   b. This pump may also be purchased as part of a kit which includes other items needed for the characterization study.

      Gravimetric Sampling Kit, Cat. No. 456241 — 288.75
      Includes:

      - Model G Portable Pump with charger
      - Respirable dust cyclone
      - Filter Holders (12) and package of filters (50)
      - Accessory Kit, instructions
      - Carrying Case

   c. MSA Model S, Portable Pump, with Battery Charger

Cat. No. 458475 (pump)	168.00
Cat. No. 456059 (charger)	42.00
Cat. No. 996338 (instruction book)	4.20

   d. Bendix C115 Personnel Monitor, with battery and charger, Part No. 3650-10 — 325.00

A flowrate calibration, which is accomplished by use of a wet test meter or bubble flowmeter, must be made for each pump as used with each type of collection device (e.g. respirable dust sampler, fluoride monitor, hydrocarbon filters etc.) For calibration, the sampling train will consist of reference flow device followed by the collector and pump, connected in that order.

*Preferred

2. Respirable Dust Sampler

a. Inorganic Dusts. This device consists of a 10-mm nylon cyclone followed by a 37-mm membrane filter of 0.8u pore size. The filter may be pre-weighed and inserted into reusable filter holder or obtained as a pre-weighed, disposable cassette. The reusable filter holder (e.g. Millipore Field Monitor) is recommended where additional chemical analysis is required because removal of the dust sample from a sealed cassette is somewhat difficult. Personal samplers for respirable dust may require sampling for approximately the entire shift (7+ hours) in order to obtain weighable quantities. The sampling device is attached to the worker's collar, and the pump attached to his belt. The sampling rate (1.7 lpm) should be checked and adjusted throughout the work shift.

The following equipment may be used:

MSA Holder Assembly, Respirable Dust, with cyclone and sampling line assembly Cat. No. 456243		$ 36.75
MSA Holder, Aerosol Filter, 3-piece, package of 10 Cat. No. 449347	Pkg.	5.25
Millipore Corp. Field Monitors, aerosol type, 0.8u pore size Cat. No. MAWP 037 AO, carton of 50	Carton	37.95
MSA Cassettes, pre-weighed, type FWS-B	Each	1.31

(Bendix pre-weighed cassettes are not recommended since OSHA has revoked its approval due to weight-loss of the cassettes on storage.)

b. Hydrocarbons. Sampling equipment consists of a 10-mm nylon cyclone followed by a special filter holder containing a 37-mm binderless glass fiber filter backed by a 37-mm silver membrane filter. The glass fiber and silver membrane filters are washed by two-bath immersion in C.P. benzene, air dried (in a chemical fume hood) until free of benzene, conditioned overnight in a desiccator, and weighed--as a pair--to the nearest 0.01 mg. The filter pair is sealed in the special filter holder and secured by a wrap of masking tape around the joints. Collection of an adequate sample generally requires at least 7 hours at the prescribed sampling rate of 1.7 lpm. Following sampling, the filter pair is removed from the holder, reconditioned overnight

in a desiccator, and weighed. The filters are then re-sealed in the filter holder and sent to EHL for analysis. Following is a list of recommended sampling equipment:

MSA Holder Assembly, Respirable Dust, with cyclone and sampling assembly. Cat. No. 456243	$ 36.75
This requires replacement of the plastic filter coupler with Coupler Assembly, stainless steel, with "O" Rings, Cat. No. 457392	2.75
Millipore Corp. Polystyrene Cassettes: Cat. No. M000 037 00, carton of 50 Polystyrene Rings	18.50
Cat. No. M000 037 RS, carton of 100	5.50
Selas Flotronics Membrane Filter (silver), 37 mm, Cat. No. FM-37-0.8u 100 circles/pkg.	100.00

3. Total Dust, Fluoride, and Sulfur Dioxide Monitors. Total dust, particulate and gaseous fluorides, and sulfur dioxide are collected on a single sample by use of a field monitor, prepared as described write-up, "Determination of Ambient Fluoride Concentration in Workroom Air." (See Appendix III)

   Where total dust is to be determined gravimetrically, the membrane filter must be conditioned overnight in a desiccator containing freshly activated alumina prior to weighing both before and after collection of the sample. To avoid loss of collected dust, the field monitor should be used in the "in-line" or "closed-face" mode; i.e., with air sample entering through the small hole in the front cover. In use, the sampler is attached to the worker's collar and the personal monitor pump at his belt. Sampling rate may be set at about 2.5 lpm and should be readjusted to the initial value, as required, throughout the work shift.

4. Hydrocarbon Sampler. Samplers are intended to collect both gaseous and particulate hydrocarbons. Solids are collected by filtration on a binderless glass fiber filter backed by a reusable silver membrane.

Volatiles are to be collected by an activated charcoal tube following the filter. The charcoal tube, available from several commercial suppliers, should be directly coupled to the filter holder. The filter and charcoal tube are attached to the worker's collar, and the personal monitor pump to his belt. Sampling rate is not critical, but a constant, known rate should be maintained throughout the work shift: 2.5 lpm for 7+ hours is generally required. Choose non-smokers for this test if selection is possible. Recommended sampling materials are the following:

Millipore Styrene Monitor Case — Per Pkg.: $ 18.50
Cat. No. M000 0370, package of 50

(The Tenite Millipore Field Monitor, Cat. No. MAWP 037 AO cannot be used for this purpose: release of plasticizer may contaminate the sample.)

Reeve Angel Glass Fiber Filters, — Per Pkg.: 100.00
Grade 934 AH, 37 mm, 100 circles/pkg.

MSA Activated Charcoal Tubes for organic vapors, 1 doz./box, Part No. 459004 — Per Box: 7.00

Environmental Compliance Corp. Luer Slip Adapter (tubing adapter) — .80
Cat. No. 360095

Suitably equipped plant laboratories should prepare filters and determine total sample weights for both Total Dust and Hydrocarbon samples. Hydrocarbon filters and activated charcoal tubes are to be sent to Environmental Health Laboratory, Alcoa Technical Center, for hydrocarbon analysis. EHL can supply pre-weighed filter cassettes for hydrocarbon sampling to plants which are unable to prepare them.

5. Detector Tubes. Detector tube-pump combinations, presently approved by NIOSH, include the following:

Carbon Monoxide

MSA, Cat. No. 91229, range 10-3000 ppm, pkg. of 12 5ubes — Pkg. $ 7.00

Universal Testing Kit, Model 1 — 82.00

Drager, Cat. No. CH25601 (5/c), range 5-700 ppm, pkg. of 10 — 10.56

Drager Detector Pump Kit, incl. case and spare parts, Cat. No. 21/31 — $110.00

Drager Automatic Stroke Counter, Cat. No. CH168 — 22.55

Sulfur Dioxide

Drager Cat. No. CH31701 (1/z), range of 1-20 ppm, pkg. of 10 tubes — 10.56

Drager Detector Pump - see above.

Evaluation of eight hour time-weighted average exposures by means of detector tubes will require a number of samples. Samples should, of course, be taken in the worker's breathing zone.

6. Carbon Monoxide Meter. As an alternative to carbon monoxide detector tubes, those plants which have carbon monoxide meters, such as the Ecolyzer (Energetics Science Inc.) or Bullard Portable CO Meter, may find them useful in this survey. In the potrooms where magnetic fields may temporarily or permanently impair the function of the indicating meter, samples are collected in plastic bags which are brought to the instrument for CO determination.

Ecolyzer, Model 2800, dual range 0-100 and 0-600 p0m — $1,090.00

Bullard Portable CO Detector, range 0-300 ppm, Cat. No. 104-200-4010 — 845.00

7. Balance. For determination of total dust, filters may be weighed with a conventional analytical balance having sensitivity of 0.1 mg. The weighing of respirable dust samples, or of hydrocarbon samples, requires a semi-microbalance (sensitivity 0.01 mg) or microbalance (sensitivity 0.001 to 0.0001 mg).

Mettler Model H-51 semi-microbalance, Capacity 160 g, sensitivity 0.01 mg, Fisher Scientific Co. Cat. No. 1-909-51 — 1,460.00

Cahn Electrobalance, Model G-2 Capacity 2.5 g, sensitivity 0.1 ug, Fisher Scientific Co. Cat. No. 20-068-5 — 1,750.00

Addresses of Suppliers:

MSA:
Mine Safety Appliances Co.
400 Penn Center Blvd.
Pittsburgh, Pa. 15235
Phone: (412) 824-9660

Drager:
Safety First Supply Company
526 Island Avenue
McKees Rocks, Pa. 15136
Phone: (412) 331-3200

Kitagawa:
Matheson Gas Products
1275 Valley Brook Avenue
Lindhurst, N. J. 07071
(201) 935-6660

Bendix:
National Environmental Instruments, Inc.
P. O. Drawer 590
Pilgrim Station
Warwick, R. I. 02888
(Phone: (401) 738-3710

Millipore:
Millipore Corporation
200 Walsh Road
Bedford, Mass. 01730
Phone: (617) 275-8800

Reeve Angel
9 Bridewell Place
Clifton, N. J. 07014
Phone: (201) 777-4825

Selas Flotronics
Box 300
Spring House, Pa. 19477
Phone: (215) 646-5950

Ecolyzer:
Energetics Science Inc.
85 Executive Blvd.
Elmsford, N. J. 10523
Phone: (914) 592-3010

Environmental Compliance Corp.
P. O. Box 55
Venetia, Pa. 15367
Phone: (412) 922-4646

B. Analytical

The following are not intended as complete analytical procedures; they are notes for the guidance of experienced analysts and call attention to special conditions or deviations from the usual methods.

1. Respirable Dust, Inorganic

Field Monitors: Remove the membrane filter from its plastic holder and recover dust from inside the cover by means of a small brush. Remove surface moisture from the filter and dust by storage in a desiccator overnight. Determine net weight of respirable dust to the nearest 0.01 mg, and calculate the concentration as shown below.

Preweighed Cassettes: If preweighed cassettes are used, the initial tare weight should be checked. On return to the laboratory the cassette should be left overnight, exposed to the air but protected from dust by a loose cover (paper- or cloth toweling), before reweighing. In this case, weighing to the nearest 0.1 mg is about as good as one can do. Two cassettes of the same batch should be subjected to the same handling as the samples--except that no air is drawn through them--and used as blanks. Oversize material caught in the grit chamber (bottom of the cyclone separator) is to be discarded.

$$\text{Respirable Dust, mg/M}^3 = \frac{W}{V}$$

where W = respirable dust, net wt., mg
V = volume of air sample, M^3

2a. Total Dust

Carefully open the filter holder and remove both the membrane filter and alkaline cellulose pad. Transfer the membrane filter with its dust deposit to a desiccator for reconditioning overnight before weighing to the nearest 0.1 mg. Calculate the concentration of total dust as shown below. Reserve the filter for determination of particulate fluoride (section 2b).

$$\text{Total Dust, mg/M}^3 = \frac{W}{V}$$

where W = total dust, net wt., mg
V = volume of air sampled, M^3

2b. Gaseous Fluoride

When sulfur dioxide is to be determined in the same alkaline cellulose pad used for collection of gaseous fluoride, modification of the analytical method will be required. In this case, disintegrate the cellulose pad by stirring in about 20 ml of water. Filter the extract into a 50 ml volumetric flask. Extract the cellulose pulp once more, then wash the pulp and filter, catching the filtrate in the same flask. Dilute to the mark, mix, and remove a 10 ml aliquot for dilution with an equal volume of TISAB. Determine fluoride by means of the specific ion electrode. Reserve the remaining filtrate for determination of sulfur dioxide (see section 2c). Calculation of gaseous fluoride in the sample will also be changed from that given in the previously cited procedure, to the following:

$$C_G^3 = 0.1 \times \frac{C_3}{V}$$

where C_G = concentration of gaseous fluoride, mg/M^3

C_3 = concentration of fluoride in the sample solution, ug/m

V = volume of air sample

The result may be expressed as ppm by multiplying C_G, mg/M^3 x 1.29.

2c. Sulfur Dioxide

Rinse the remaining sample solution (section 2b) from the volumetric flask into a 250 ml beaker, acidify to Methyl Red indicator with dilute hydrochloric acid, and add a few milliliters of saturated bromine water. Boil the solution to remove excess bromine, then precipitate sulfate by slow addition of barium chloride solution to the boiling sample solution. Filter, wash, ignite, and weigh the barium sulfate. Deduct a determined blank and calculate the result as sulfur dioxide.

$$SO_2,\ mg/M^3 = 0.3431 \times \frac{W}{V}$$

where W = barium sulfate, net wt., mg

V = volume of air sample, M^3

0.3431 = conversion factor, ($BaSO_4$ to SO_2 x aliquot factor)
SO_2 may also be expressed as ppm by multiplying concentration in mg/M^3 by 0.382.

APPENDIX III

Analytical Methods

Determination of Ambient Fluoride Concentration in Workroom Air[1]

The method is applicable to the collection and separate measurements of gaseous and particulate fluorides. Gaseous inorganic fluorides collected are reported in terms of hydrogen fluoride; the procedure is not applicable to the collection or analysis of other fluoride-bearing gases (e.g., fluo-carbon or fluo-sulfur compounds).

Apparatus

1) Personal sampling pump (Mine Safety Appliances Co. Model G or equivalent) 2) Filter holder. Plastic holders of the preloaded personal monitor type, which accept filters of 37 mm diameter, are preferable;[2] 3) 37 mm membrane filter of mixed cellulose esters, 0.8 um pore size and cellulose pad to fit the filter holder; 4) Fluoride ion selective electrode with reference electrode of the calomel type, preferably combined with the fluoride specific electrode (Orion Research Inc., Cambridge, combination fluoride electrode No. 96-09 or equivalent); 5) An electrometer or expanded scale pH meter with a millivolt scale for measurement of potential (Corning Model 12 research pH meter expanded scale or equivalent)

---

[1](Method has been submitted to ASTM Committee D-22 for consideration as a tentative method.)

[2]These are supplied with a membrane filter and cellulose backup. The pad is not impregnated as supplied.

Reagents

1) Alkaline Fixative Solution - dissolve 25 g sodium carbonate (Na_2CO_3) in water, add 20 ml glycerol, and dilute to 1 liter; 2) Total Ionic Strength Buffer - dissolve 37 g potassium chloride (KCl), 68 g sodium acetate ($NaC_2H_3O_2.3H_2O$), and 294 g sodium citrate ($Na_3C_6H_5O_7.2H_2O$) in water, adjust to pH 8 ± 0.1, and dilute to 1 liter; 3) Standard Fluoride Solution, 100 ppm - dissolve 0.2211 g sodium fluoride (NaF, dried at 105°C for 2 hours) in water and dilute to volume in a 1-liter volumetric flask; 4) Ethanol, denatured; 5) Borate-Carbonate Fusion Mixture - intimately mix a 1:2 (w/w) combination of sodium tetraborate ($Na_2B_4O_7$) and sodium carbonate (Na_2CO_3).

Preparation of Monitors

Disassemble the personal monitor, removing the membrane filter and cellulose pads. Moisten the pad with a measured volume of alkaline fixative solution; 0.8 ml is required for a pad of 37 mm diameter. Dry the pad at 105°C for 30-45 minutes. Preparation of alkali-impregnated pads must be carried out in a low-fluoride environment with minimum exposure.

Reassemble the filter monitor, inserting an impregnated pad behind the membrane filter. Seal the assembly by wrapping with masking tape.

Sampling

By means of a personal sampling pump, air at the calibrated rate is drawn through the filter assembly which is attached to the worker's collar.

Calibration

1) Fluoride Standards, Particulates - Add 1.0 g borate-carbonate fusion mixture to each of four 250 ml beakers containing 10 ml water and 50 ml total ionic strength buffer. Add various size aliquots (1, 5, 10 and 25 ml) of 100 ppm standard fluoride solution to produce a series of working standards (1, 5, 10 and 25 ug F/ml). Adjust each solution to pH 8 ± 0.1 with 1:1 hydrochloric acid, transfer to a 100 ml volumetric flask, and dilute to volume with water. These standards may be stored for several months in tightly-capped polyethylene bottles under refrigeration.

For calibration of the electrode, pour about 20 ml of the working standard solution into a plastic beaker containing a Teflon^{R}-coated stirring bar. Adjust solution to within ± 2°C of an arbitrarily selected "standard" temperature. Insert the fluoride and reference electrodes into the constantly stirred solution and record the potential after two minutes. Repeat for each of the working standards. Prepare a calibration curve, on three cycle semilog paper, relating potential, in millivolts (linear scale), to concentration of fluoride in ug/ml (log scale). Reproducibility of each point should be ± 1 millivolt. A linear calibration curve is obtained in the 0.1 to 25 ug/ml range, with a slope of between 57 and 59 millivolts per tenfold change in fluoride concentration.

If solutions containing less than 0.1 ug/ml are measured, additional standards must be prepared since the calibration curve is not linear at low fluoride concentrations.

2) Fluoride Standards, Gaseous - Into each of four 250-ml beakers, place 10 ml water and 50 ml total ionic strength buffer. Add various size aliquots (1, 5, 10 and 25 ml) of 100 ppm standard fluoride solution to produce a series of working standards (1, 5, 10 and 25 ug F per ml). Adjust each solution to pH 8.0 ± 0.1 with 1:1 hydrochloric acid, transfer to a 100-ml volumetric flask, and dilute to volume with water. Prepare a separate calibration curve for gaseous fluoride from potential measurements of these standards by the same procedure as used for particulate fluorides.

Procedure

1) Particulate Fluoride - Remove the membrane filter from the filter holder and place it in a nickel or Inconel crucible containing about 0.5 g borate-carbonate fusion mixture. Drench the filter with ethanol and ignite with a small gas flame. Heat the residue to fusion temperature for 1 to 2 minutes, then cool and dissolve in a few milliliters of water. Transfer the sample solution into a plastic beaker by means of 25 ml total ionic strength buffer followed by a rinse of the crucible with a few drops of 1:1 hydrochloric acid. Adjust to pH 8 ± 0.1 by further addition of 1:1 hydrochloric acid. Adjust to pH 8 ± 0.1 by further addition of 1:1 hydrochloric acid. Dilute to 50 ml in a volumetric flask, mix and bring to standard temperature. Pour about 20 ml of the solution into a

plastic beaker and read the potential while the electrodes are immersed in the gently stirred solution. Convert potential (mv) to fluoride concentration (ug/ml) by means of the calibration chart determined from the standard fluoride series containing borate-carbonate flux.

2) Gaseous Fluoride - Transfer the impregnated cellulose pad to a 100 ml plastic beaker containing 25 ml water and 25 ml total ionic strength buffer. Allow the pad to soak for about 30 minutes with sufficient stirring to reduce it to a pulp. Bring the solution to standard temperature, insert the electrodes, and read potential of the gently stirred mixture after two minutes. Convert potential (mv) to fluoride concentration (ug/ml) by means of the calibration chart determined from the standard fluoride series.

Interferences

Because a specific ion electrode responds to ionic activity, insoluble and complexed forms of fluoride must be released by appropriate combinations of fusion, adjustment of pH and addition of complexing agent. Acidity (pH) and ionic strengths of fluoride standard solutions must be matched to those of samples and the temperature of sample and standard solutions must be controlled within $\pm$ 2°C.