Review of Work Conducted by Trussell Technologies on the Nature of the Particulate Solids in the Santa Ana Watershed Project Authority (SAWPA) Brine Line

By

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1. Over the period from mid-2001 to the present Trussell Technologies Inc. (TT) have conducted studies related to the nature of the particulate suspended solids (solids) in the Santa Ana Watershed Project Authority (SAWPA) Brine line (the Line). These studies had their origin in the observation that the concentration and amount of solids at the Line's transfer point from SAWPA to Orange County Sanitation District (OCSD) was significantly in excess of the concentration and amount of solids entering the line from its various dischargers.

2. TT's investigations can be grouped into the following categories:
   (i) Determination of the composition of the solids present at the above-mentioned transfer point.
   (ii) Investigation of sampling procedures and resolution of problems identified by this investigation.
   (iii) A limited amount of work on the mechanism(s) of the formation of inorganic solids in the Line.

3. At the outset I would like to state my opinion that all of the work done by TT in all of the above-mentioned categories was conducted in a careful and insight fashion using appropriate methodologies. TT's conclusions were sound and supported by the data obtained.

4. The solids present at the Line's transfer point were found to be made up of (in order of magnitude) Calcium minerals, Cellulose, "Bio-Organics" (organic matter associated with microbial cells), Silicate minerals, other unspecified inorganics and water (of crystallization and/or hydration). The calcium minerals were largely calcium carbonate and to a lesser extent calcium phosphate. To make these determinations TT employed a wide range of appropriate standard and "advanced" analytical techniques. These included Thermogravimetric Analysis (TGA), X-Ray Diffraction (XRD), Inductively Coupled Plasma Spectroscopy (ICP), Fourier Transform Infrared Spectroscopy

(FTIR), Fluorescence Microscopy (FM), Scanning Electron Microscopy (SEM) and Heterotrophic Plate Counts (HPC)

5. Investigations of the sampling methods at the Line's transfer point yielded information that went a long way to explaining the apparent increase in solids levels in the Line. Investigations were made first at the Green River Metering (GRM) facility and then at the newly-constructed Canyon RV Park (Canyon) sampling station when this became the official Line transfer point to OCSD. At GRM the sampling was found to be unrepresentative for Line solids because of dead space in the sampling port, deposition of solids in the sampling port and a fluctuating velocity profile at the sampling port. These issues were resolved by modifications to the sampling port and by increasing the volume of sample collected. These changes significantly reduced the solids increase in the Line from approximately 200% to approximately 60%. When it was placed in service the new sampling station Canyon was evaluated and found to be lacking in regard to missing samples. Again TT's careful investigations of the problems led to a markedly more satisfactory sampling performance although occasional missed samples continue to occur.

6. TT proposed the following mechanisms for solids increase in the Line: (i) precipitation of inorganic solids including calcium carbonate, calcium phosphate and silica, and (ii) biomass framed from growth on soluble organics in the waste stream. In addition to these the solids also contain cellulosic material (likely from toilet paper) and the solids (both organic and inorganic) present in the wastes discharged to the Line. The above statements have been largely confirmed by TT's investigative work.

7. Even with the sampling issues resolved, there still appears to be a substantial increase in solids in the Line. Thus it would be fruitful to further investigate: (i) the points in system where increases occur; (ii) the occurrence of changes in solids composition throughout the Line, especially at points where increases occur; the sources of various solids components (especially cellulosic solids).

8. Suggestions for future work:

(i) Continue monitoring the composition of solids at the new SAWPA/OCSD quantity and/or composition occur. When performing these investigations use the filtration and washing techniques described in Method 2540D, 3a in the 22nd edition of Standard Methods (2012), to ensure that the solids retained on filter do not contain residue from the dissolved solids that present in the brine. Also observe Method 2540D, 3b guidance on sample volume to be filtered and filtration time;

(ii) Continue monitoring of sampler performance with special reference to determining whether it is possible to eliminate the occasional missed samples, to evaluate the effectiveness of the sampler purge cycle and to detect and resolve any further issues that may occur;

(iii) Conduct experiments to confirm proposed mechanism(s) of inorganic precipitate formation. This could involve pipe loop experiments and observations from Line sampling described below. In addition it would be valuable to evaluate the composition of the waste discharges themselves using the solids fractionation methods applied to the solids in the Line at the SAWPA/OCSD transfer point sampling station

(iv) A cursory determination of the percentages of brine wastewater and domestic/industrial wastewater revealed that the various legs of the Line contain a wide range of compositions as follows (Table 1). It would be interesting to determine whether it is possible to assign the formation of inorganic solids to a particular Line leg or a segment of this Line leg. There may be some control possibilities if this occurred.

(v) An important Goal for future work should be to provide information that will allow a rational assignment of costs to dischargers based on the contribution of their discharge to any increases or decreases in BOD and/or solids that occur in the Line;

(vi) Perform a forensic analysis of the cellulosic material in the Solids to determine its likely source;

(vii) The priority of the above recommended actions is as follows: 8(i), 8(ii), 8(iii), 8(iv), 8(v) all high; 8(v) lower.

Table 1. Approximate Proportions of Brine Flow and Domestic and Industrial Flow in the Various Line Segments

Line Segment*	Brine flow, %	Domestic/Industrial flow, %
V	99.6	0.4
IVB	75	25
IVE	64	36
IVA	27	73
IVD	19	81

Reference

Standard Methods for the Examination of Water and Wastewater, 22nd edition (2012). Amer Publ Hlth Assoc, Amer Water Wks Assoc, Water Environ Fedn.