FACTSHEET

Smith & Loveless, Inc.
Manufacturers of quality treatment systems

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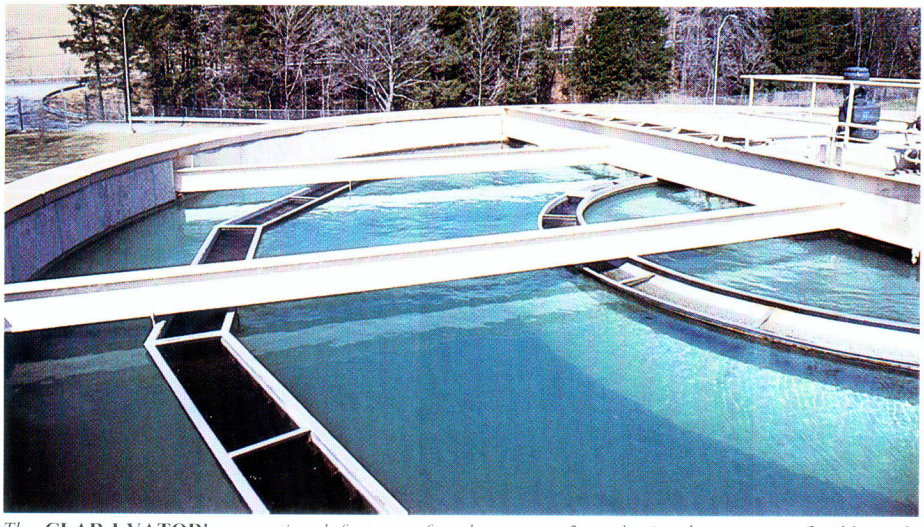
The CLAR-I-VATOR®

The Smith & Loveless **CLAR-I-VATOR** is a high rate, solids contact clarifier used for economical and efficient chemical precipitation in water and wastewater treatment applications. Suitable for municipal and industrial applications, the **CLAR-I-VATOR** lends itself to both variable rate or stop-start operation.



The **CLAR-I-VATOR's** *operational features, found on page 2, make its design more flexible and superior to sludge blanket units.*

Design Benefits

- Combines flash-mixing, flocculation, clarification, sludge collection and sludge thickening in one unit operation and tank.
- Minimizes the amount of chemicals needed due to use of the solids contact or "seeding" principle.
- Provides the most complete and rapid chemical reactions possible.
- Provides a stable process operation that is less dependent on incoming flow variations.
- Simplifies the operation to ensure reliable results and requires only a minimum of operator attention compared to typical sludge blanket designs.
- Provides the highest effluent quality possible because of deep clear water zone.

Applications

Water Treatment

- River or well water treatment
- Clarification/turbidity removal
- Water softening
- Taste and color control

Wastewater Treatment

- Phosphorous removal
- Suspended solids removal
- Precipitate removal from industrial wastewater

Understanding the Application of CLAR-I-VATOR® Solids Contact Clarifiers

Clarification and sedimentation involves several basic approaches from a design and process point of view. From a design angle, there are conventional center feed clarifiers, higher rate Lamella Separators and conventional clarifiers equipped with tube settlers.

From a process point of view, the achievement of sedimentation with an economical use of chemicals, or where influent suspended solids are relatively low for sedimentation unit operations, or where a chemical reaction is taking place, is usually best achieved in one operation by the use of a solids contact clarifier such as the Smith & Loveless **CLAR-I-VATOR®**.

From a design point of view, it's desirable to create an environment where the settling time is minimized by shortening the settling distance yet minimizing turbulence and short-circuiting. If this environment is achieved, it will optimize clarification. In many instances, the use of chemicals and flocculating techniques are not important so a conventional **center feed clarifier** will do the job. In some cases though, clarifier performance can improve, or space can be limited in which the process is achieved either by using a conventional clarifier equipped with **tube settlers** or a **Lamella-type separator** equipped with plates. Both the tube settlers and the plate separators essentially reduce turbulence and shortening of the settling distance, thereby achieving the desired results.

With chemical utilization, the concept of flocculation or the development of a more readily settleable particle becomes a consideration; therefore, a flocculating clarifier which performs the solids agglomeration step in one tank along with sedimentation may be preferred. Otherwise, a separate chemical addition and flocculating step will be required before the conventional clarifier, a clarifier equipped with tube settlers, or a Laminar plate-type settler.

However, a **sludge blanket clarifier** and a **solids contact clarifier** can both perform the chemical conditioning function and sedimentation function in one tank, yet do it in a more effective manner than in the case of the flocculating clarifier. (generally,there are always some exceptions to the rule).

In a sludge blanket clarifier, chemicals are added internally with some form of flocculating mechanism such as a horizontal paddle or a vertically mounted re-circulator. Chemicals are added, the fluid mixed, and flocculation occurs in a particular zone of the tank. These materials are then directed toward the bottom and then will eventually rise towards the surface and form a sludge blanket. The sludge blanket exhibits a density gradient where the particles closer to the bottom have a less discrete form, and the particles near the top become discrete and increase in size where they eventually drop out of the sludge blanket and settle. It is by contact between a settling particle and the sludge blanket that sedimentation occurs.

The Smith & Loveless **CLAR-I-VATOR®** *is a solids contact clarifier.*

This can be an efficient form of sedimentation. However, with the sludge blanket clarifier, the device is readily upset by flow and process changes; if the sludge blanket is disturbed in any way, it will collapse, and the necessary exchange phenomena for removal by chemical means and by sedimentation due to growing and size of a particle will be altered unfavorably.

A **CLAR-I-VATOR®** solids contact clarifier overcomes some of the problems exhibited in the sludge blanket clarifier. It basically controls the chemical reactions taking place, flocculation, and the sedimentation phenomena more positively than in a sludge blanket clarifier and is not as readily affected by changes and flows or by process.

In the **CLAR-I-VATOR®** solids contact clarifier, the liquid stream enters into a central detention zone where chemicals

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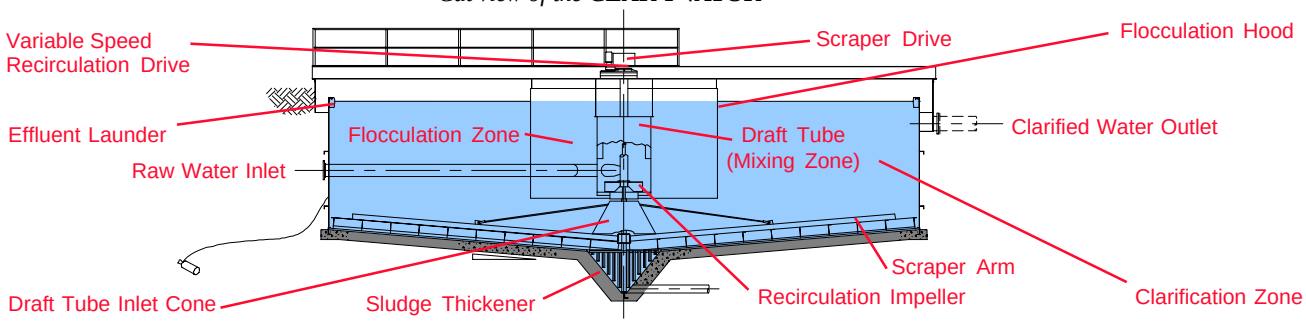
Cut view of the **CLAR-I-VATOR®**



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can be added. Within this zone, there is a re-circulator paddle which is activated by a variable speed drive. This paddle creates a pressure differential within this zone and essentially pumps previously settled material from a central settling cone into the re-circulation zone and positively contacts it with the incoming waste. In so doing, the incoming waste can be flocculated with chemicals added at that point. The incoming solids create a thermodynamically favorable environment to bring a chemical reaction to completion, conserve chemicals and provide a more favorable settling characteristic to the solid. These contacted materials are then brought into a detention zone where true flocculation can occur. At this point, the materials fall out and settle into the clarifier. It is not the intent of a **CLAR-I-VATOR®** solids contact clarifier to maintain a sludge blanket, although they are periodically operated in that fashion.

In addition, to the enhanced settling characteristic imparted by the **CLAR-I-VATOR®**, chemical reactions can occur and take place in a more ideal environment. Not only can we achieve simple sedimentation in an enhanced manner, but reactions such as the removal of phosphates by precipitating calcium phosphate, or the removal of arsenic by the addition of iron in a complexation reaction, can be maintained as well as others. Activated carbon could also be added to the **CLAR-I-VATOR®** for absorption.

In summary, the **CLAR-I-VATOR®** solids contact clarifier can enhance sedimentation by improving the physical characteristics of the material to be removed, can remove materials by utilization of chemical reactions because of ideal reacting environment, can maximize the use of chemicals as previously settled material can be used as a source of these reactants and chemicals, and chemicals can be added in both the re-circulation and flocculating zones.

One other consideration should be made for use of a solids contact clarifier over a conventional clarifier. Because of the efficiencies described above, a **CLAR-I-VATOR®** solids contact clarifier might often use a smaller space than a conventional clarifier. However, it is not uncommon to have relatively low solids concentration applications where conventional clarification simply will not do the job. Typically, depending upon the nature of the liquid to be treated, do not expect a clarifier to put out less than 10 PPM suspended solids — often the range is 10 to 30 PPM. When treating a flow that has less than 200 PPM suspended solids, that's demanding a lot in terms of percentage reduction with a conventional clarifier. In these cases, chemical enhancement may be required — thus, a solids contact clarifier can do a much better job.

When considering applications with several hundred or thousands of PPM suspended solids, the conventional clarifier may be the better choice. In the case of low influent suspended solids, create an environment where sufficient particles contact each other so that sedimentation can occur. Of course, if the particles are sufficiently large and discrete that they settle rapidly, this is not a problem — but it is the exception, not the rule. When re-circulated sludge contacts with an influent stream, a crystallization effect occurs where settleable material is created. This parallels the concept behind adding a chemical additive such as lime to an influent waste just for the matter of adding "weight" to the settleable material. Improving the settling efficiency is the result.

In water treatment applications, the **CLAR-I-VATOR®** can be easily applied because without the re-circulation and contacting of the solids, the high rates required for economy are not available for settling nor will the necessary chemical reactions be carried out very effectively.

There are a host of applications in water and wastewater treatment that employ a variety of clarification and sedimentation techniques. However, in many cases, the **CLAR-I-VATOR®** solids contact clarifier is by far the more efficient unit process available.

SMITH & LOVELESS INC.
Innovators for global pumping, water and wastewater treatment

smithandloveless.com

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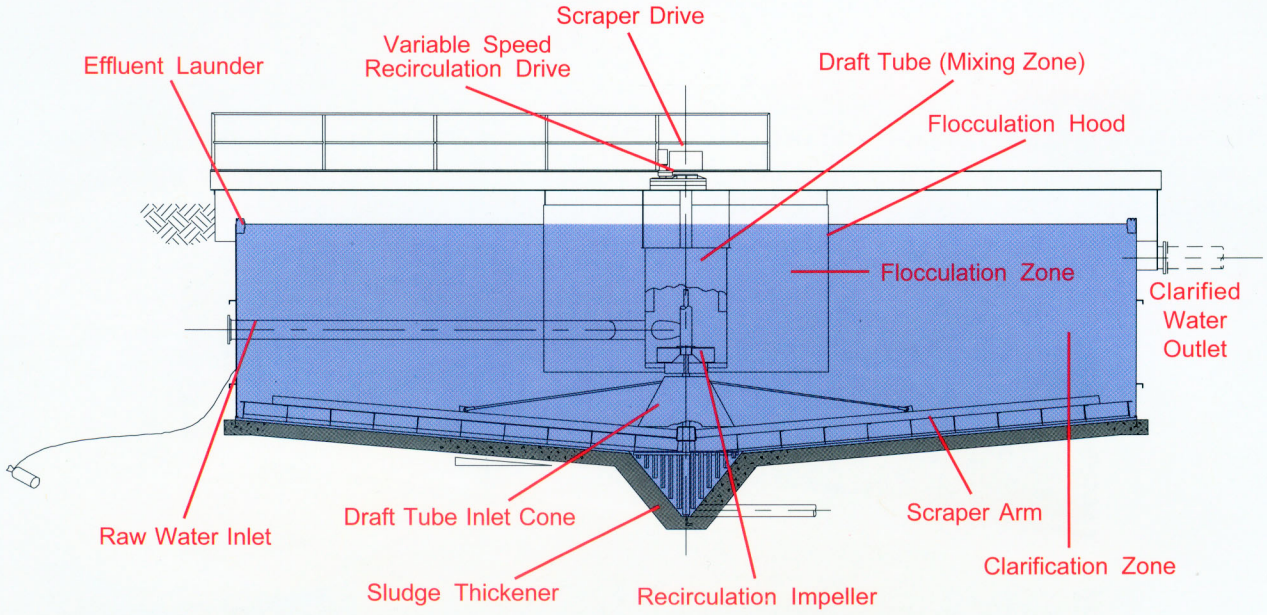
The CLAR-I-VATOR



Design & Operation

- Positive internal recirculation upflow design does not depend on a sludge blanket for reaction points, thereby permitting radical changes in flow rate without deterioration of treated water quality.
- Recirculation system recirculates 3-5 times the design output flow. The entire recirculation flow is confined in the mixing zone, with only the treated effluent flowing out from under the central flocculating hood and into the clarified water zone.
- Variable speed impeller positively mixes and recirculates raw water, treating chemicals, and previously formed precipitates in the primary mixing zone, allowing for flocculation in the secondary zone.
- Equipped with a positive, separately driven sludge scraper, which rotates over the entire bottom flow area of the unit and discharges into a centrally located sludge sump.
- Removes not only the flocculant precipitates formed in operation, but also any gritty sand, silt or other similar materials which would settle out readily from the raw water supply.
- Positive internal sludge recirculation equipment readily lends itself to variable flow rate or stop-start operation.

Sizing

- Available in various sizes ranging from 10' (3.1 m) to 70' (21.3 m) diameter.
- Several flocculation hood sizes are available for each diameter to provide flexibility in the rise rate and flocculation zone detention time selection.
- The 10' (3.1 m) through 40' (12.2 m) diameter units have a standard side water depth of 13'-0" (4 m) and the 45' (13.7 m) through 70' (21.3 m) diameter units have a 15'-0" (4.6 m) side water depth.

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