A METHOD FOR DETERMINING SEASONAL CHANGE FOR WATER PARTICLES

Field of the Invention

The present invention relates to a method for determining seasonal change for water particles.

Background

Inter basin water transfer typically involves the mixing of water from respective basins. The water transfer can take place during seasonal changes, and the transfer also affects the particles in the water. The particles comprise both dissolved particles and non-dissolved particles.

It is currently uncertain how the dissolved particles affects the quality of the non-dissolved particles due to seasonal temperature changes and the interaction with the non-dissolved particles.

Summary

There is provided a method for determining seasonal change for water particles, the method comprising:

obtaining water samples;

obtaining test samples from the water sample;

measuring a mass M_1 of each test sample;

locating each test sample at a position with a pre-determined temperature;

extracting half volume of each test sample after allowing the test sample to be stationary for 24hrs, the half volume being from an upper portion of the test sample;

measuring a mass M_2 of remainder of test sample; and

determining precipitated mass TP of each test sample.

It is advantageous that spatial distance changes and data for seasonal variation is derivable.

It will be appreciated that the broad forms of the invention and their respective features can be used in conjunction, interchangeably and/or independently, and reference to separate broad forms is not intended to be limiting.

Brief Description of the Drawings

A non-limiting example of the present invention will now be described with reference to the accompanying drawings, in which:

FIG 1 is a flow chart of an example of a method for determining seasonal change for water particles;
FIG 2 shows a chart of the precipitate level from different locations; and
FIG 3 shows an example area for implementation of the method of FIG 1.

Detailed Description

The present invention provides a method for determining seasonal change for water particles. The method is able to assist in enabling an understanding of inter basin water transfer which typically involves the mixing of water from respective basins. Correspondingly, this method can be applied to determine water quality. The water quality is determined by measuring a precipitated mass from the dissolved substance inside a water body during long-distance and long-duration inter basin water transfer. The method can advantageously be used to separate dissolved particles in a water body, although this is a minor objective. The method has eliminated perturbation but retained tracing the mass exchange in this micro process naturally with solid particles acting as an “indicator”.

For the purpose of illustration, it is assumed that the method can be performed at least in part using one or more machines, and can be automated when possible.

It should be noted that the present method is unable to track particles that do not precipitate out. Referring to FIG 2, there is shown a chart of precipitate levels from different locations for illustration, namely:

- ZhongWei, TengGeLi desert with embankment;
- ZhongNing, without artificial structure; and
- QingTongXia.

Referring to the chart of FIG 2, it should be noted that the precipitate levels as indicated do not mean that all the dissolved solid matter has precipitated in each sample.

An example of a broad overview of a method 100 for determining seasonal change for water particles will now be described with reference to FIG 1.

The following two equations are applied in the method 100:

$$PM_T = 2M_2 - M_1 \qquad (1)$$

where PM_T is total mass of precipitated and solid particle under temperature T, M_2 is mass with reduced half test sample, M_1 is mass of test sample. T is the seasonal temperature, and the precipitated mass TP by a temperature variation from T_1 to T_2 is calculated by,

$$TP = PM_{T2} - PM_{T1} \qquad (2)$$

Referring to FIG 1, at step 105, water samples are collected at different seasons and different geographical locations, namely, spring (A), autumn (B), winter (C) and summer (D). It is preferable that the water samples are collected during a middle portion of each season as in-situ field test data. It should be noted that the seasonal data is obtained in consecutive seasons, and at estimated geographical locations of where a particular body of water has been transported to over the course of a time period. For example, in the Yellow River, if the speed is 0.10m/s, 90 days distance is 778km lasting a consecutive season time period.

At step 110, a test sample of 200ml to 300ml is obtained from each sample.

At step 115, a mass M_1 for each test sample (A) to (D) is measured, and the four test samples are placed in a static manner at room temperature (A and B), low temperature (C), and high temperature (D) respectively. It should be noted that low temperature relates to ambient winter temperature, while high temperature relates to ambient summer temperature.

At step 120, 1/2 upper volume of each test sample is extracted. After standing for one day, the upper layer should comprise clean (particle-free) water.

At step 125, the mass of the remaining 1 / 2 volume of lower water body containing all solid particles, M_2 is measured.

At step 130, a determination of a precipitation mass of each sample at different temperatures is carried out according to formulae (1) and (2) as provided above.

At step 135, data differentiating spatial distance changes as well as the data of seasonal variation is obtained for samples obtained upstream or downstream of the water system. Engineering structures such as barriers and dams may have significant effects on flow pattern, velocity, and capacity of carrying and dissolving substances of

the water system, so that different river zones usually have different precipitation mass.

The determination of precipitation mass can also indirectly explain the change of crystal phase spectrum peak position and intensity of long-time and long-distance solid particles, including precipitated substances at the molecular level. Typically, the phase angle of crystal substances is changed with modification of molecular structure. For example, in a high vortex environment like Yellow River, molecular diffusion will be enhanced over a long distance, with seasonal temperatures co-relating to this molecular diffusion. Without artificial structures, for a long river as Yellow River with high concentration of solid particles, the precipitated substances have been shown to be rebalanced significantly in short durations such as a single year. Unfortunately, this rebalance doesn't exist in an artificial environment. When rebalancing doesn't occur, some substance will move into particle molecular directly such as NaCl addition to particle molecular from Yellow River source region which is a simple observation. However, “shift” of spatial phase angle is not a simple phenomenon, and is often observed for projects involving hydro-dams and long distance water transfer.

The method 100 is suitable for assessing water transfer across river basins, particularly a situation where two different sources of water contain different dissolved particles. This enables the ability to track changes of the precipitated substances with seasonal temperature and/or with distance from where the mixing occurred.

For example, referring to the area shown in FIG 3, the particles carried by the Yangtze River water may not remain dissolved if it enters the Yellow River. It is very likely that there will be precipitation from the Yangtze River water. This precipitation leads to a shift of the mass center of gravity in the crystal phase spectrum.

It should be noted that the method 100 can be used before and after the water transfer. For the sake of illustration, the solid particles carried by the Yellow River includes common particles as particles found in the Yangtze River. The molecular

characteristics, ie, some substances that did not exist before and are derived from the Yangtze River, then this is caused by the water transfer.

Therefore, it is possible to determine the change in the molecular structure after the water transfer, and determine whether it is related to the water transfer. An assessment of the environmental impact of land extension of the sea area and/or dam/barrier implementation of a single water system can be carried out.

For the sake of illustration, the follow samples were collected for laboratory tests. It should be noted that the laboratory tests differ from the in-situ tests of the method 100. However, the laboratory tests are able to validate the results from in-situ tests and that is the purpose for the samples provided below. It should be appreciated that while laboratory tests are carried out at a lower cost of in-situ tests, they are only for validation of the in-situ tests, and cannot be used to replace the in-situ tests.

i) ShaPoYou 1, Yellow River (no physical structures)

Test temperature: 22.5^{o}C; Sample collection temperature: 22.6^{o}C

M_1= 53.82-32.71 = 21.11g/20ml;

where 21.11-20 = 1.11g/20ml, which is “precipitated + dissolved +solid particles” mass in water column, i.e., 55.5kg/m^3;

M_2= 43.49-32.71 = 10.78g/10ml, i.e., 10.78-10=0.78g/10ml, i.e., 78kg/m^3

thus according to equation 1, under natural temperature T =22.6^{o}C;

PM_T= 2M_2 - M_1= 2*10.78-21.11 = 0.45 g/20ml as “precipitated mass + solid particles” outside water molecular under natural temperature, i.e., 22.5kg/m^3 with dissolved mass 55 – 22.5 = 32.5 kg/m^3 inside water.

ii) ShaPoYou 2, Yellow River (no physical structures)

Test temperature: 22.3^{o}C; Sample collection temperature: 22.61^{o}C

M_1= 53.97-32.71 = 21.26g/20ml;

where 21.26-20 = 1.26g/20ml, which is “precipitated + dissolved +solid particles” mass in water column, i.e., 63kg/m^3;

M_2= 43.61-32.71 = 10.90g/10ml, i.e., 10.90-10=0.90g/10ml, i.e., 90kg/m^3

thus according to equation 1, under natural temperature T =22.6^{o}C;

PM_T= 2M_2 - M_1= 2*10.90-21.26 = 0.54 g/20ml as “precipitated mass + solid particles” outside water molecular under natural temperature, i.e., 27kg/m^3 with dissolved mass 63 – 27 = 36 kg/m^3 inside water.

iii) ShaPoYou (Heated), Yellow River (no physical structures)

Test temperature: 73.1^{o}C; Sample collection temperature: 22.61^{o}C

M_1= 54.26-32.72 = 21.54g/20ml;

where 21.54-20 = 1.54g/20ml, which is “precipitated + dissolved +solid particles” mass in water column, i.e., 77kg/m^3;

M_2= 44.15-32.72 = 11.43g/10ml, i.e., 11.43-10=1.43g/10ml, i.e., 190kg/m^3

thus according to equation 1, under summer simulated temperature T =73.1^{o}C;

PM_T= 2M_2 - M_1= 2*11.43-21.54 = 1.32 g/20ml as “precipitated mass + solid particles” outside water molecular under natural temperature, i.e., 66kg/m^3 with dissolved mass 77 – 66 = 11 kg/m^3 inside water.

iv) ShaPoYou (Heated), Yellow River (no physical structures)

Test temperature: 73.1^{o}C; Sample collection temperature: 22.61^{o}C

M_1= 53.85-32.72 = 21.12g/20ml;

where 21.12-20 = 1.12g/20ml, which is “precipitated + dissolved +solid particles” mass in water column, i.e., 56kg/m^3;

M_2= 43.45-32.72 = 10.72g/10ml, i.e., 10.72-10=0.72g/10ml, i.e., 72kg/m^3

thus according to equation 1, under summer simulated temperature T =73.1^{o}C;

PM_T= 2M_2 - M_1= 2*10.72-21.12 = 0.32 g/20ml as “precipitated mass + solid particles” outside water molecular under natural temperature, i.e., 16kg/m^3 with dissolved mass 56 – 16 = 40 kg/m^3 inside water.

PM_T, i.e., “precipitated mass + solid particles” with solid particles provides an indicator of water purity. A low PM_T is usually associated with higher purity, and consequently, better water quality, such as Yangtze River. However, in some instances, a low PM_T does not indicate better water quality as PM_T relates to two parameters, i.e. (1) mass of dissolved substance; (2) what kind of substances are dissolved. For example:

i. The QingShui River includes artificial substances dissolved along the river. Water in the Qingshui River originates from mountains of GuYuan. When the water reaches estuary to the Yellow River at ZhongNing, though still clear, the taste is salty, which indicates low water quality with high dissolved mass.

ii. Low PM_T may also indicate substances such as artificial radioactive substance or natural dangerous virus, which are precipitated out from water and merged into solid particle molecular. This is hazardous.

Throughout this specification and claims which follow, unless the context requires otherwise, the word “comprise”, and variations such as “comprises” or “comprising”, will be understood to imply the inclusion of a stated integer or group of integers or steps but not the exclusion of any other integer or group of integers.

Persons skilled in the art will appreciate that numerous variations and modifications will become apparent. All such variations and modifications which become apparent to persons skilled in the art, should be considered to fall within the spirit and scope that the invention broadly appearing before described.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A method for determining seasonal change for water particles, the method comprising:

obtaining water samples;

obtaining test samples from the water sample;

measuring a mass M_1 of each test sample;

locating each test sample at a position with a pre-determined temperature;

extracting half volume of each test sample after allowing the test sample to be stationary for 24hrs, the half volume being from an upper portion of the test sample;

measuring a mass M_2 of remainder of test sample; and

determining precipitated mass TP of each test sample,

wherein spatial distance changes and data for seasonal variation is derivable.

2. The method of claim 1, wherein the test samples are between 200ml to 300ml in volume.

3. The method of either claim 1 or 2, wherein the pre-determined temperature is selected from at least one of: low temperature, room temperature, and high temperature.

4. The method of any of claims 1 to 3, wherein $TP = PM_{T2} – PM_{T1}$ and $PM_T = 2M_2 – M_1$.

5. The method of any of claims 1 to 4, wherein the water samples are obtained over consecutive seasons.

6. The method of any of claims 1 to 5, wherein the water samples are obtained from different geographical locations.

7. The method of claim 6, wherein the different geographical locations are determined from a rate of water flow.