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Three Gorges Reservoir "Algae Bloom" Cause Condition Investigate

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With the monitoring, The disquisitive"algae bloom" in Three gorges reservoir, frae point of view for reservoir circulate, water character, weather, temperature abundant azote abundant phosphor, accrue spend, PH, delay glide, anatomy cause of formation condition and character that big model reservoir abundant alimentation, point out hydraulics condition alter solicitation of base, confirm especially different interactional of colligate course bring on "algae bloom" break out water character state of affairs,human character ,physics chem. abc warfare course ,sedimentation, adsorb, abc warfare fall among .bring forward prevention and cure Three gorges reservoir algae bloom many knowledge tackle key problem of system engineering.

Key words: Three Gorges Reservoir, Algae bloom, Cause of formation, Water character state of affairs.

The water level of Three gorges reservoir is at a height of 175m above sea level, and there is about $3.93\times10^{10}m^3$ water in that reservoir. The Changjiang River which main channel is about 710km long has about 50 tributaries in that area, and its surface area are about $1080km^2$. The reservoir which involves 4 counties of hubei province and 15 counties of chongqing city lies in the west of china where has a low level of economic situation. The construction of water conservancy can't only drive economy of local agriculture, but also make local ecosystem become unstable in a period of time. Because of the adjustment and development of local agriculture, the increase of pollutant from hennery, fishpond, pesticide, chemical fertilizer, membrane and straw will destroy local water environment and accelerate the course of eutrophication.

Three Gorges reservoir area is located in the western region, the regional economic and social development level is not high. Water conservancy construction led the agricultural economy of the reservoir area, also follow water over a period of time the ecological environment of the Three Gorges Reservoir Area into the sensitive period, due to the economic adjustment and development of a tributary of the reservoir area surrounding agricultural, livestock, aquaculture, the increase in non-point source pollution load caused by pesticides, fertilizer, plastic sheeting, straw, on[1] the protection of the water environment in the reservoir area, causing tremendous pressure, accelerate the process of eutrophication of reservoirs.

The Three gorges reservoir has begun storing water for 3 years from june 2003, "algae bloom" is a particular infectant event in the course of super water conservancy . This paper will discuss the "algae bloom" which happen in some tributaries and reservoir after Three gorges reservoir is completed, and give some idea which aim at the reason and mechanism about the cause of "algae bloom".

Basic situation of algae bloom*f*

After Three gorges reservoir had stored water, "algae bloom" which last some days has happened in tributaries of reservoir on 3,4,5,6, 2009

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and 3,5,6, 2010. Content about that is in table 1.

In march2009,we monitored the section of tributaries which "algae bloom" happened in reservoir area. Method for water Monitoring and assessment came from 0Environmental quality standards for surface water0(GB3838-2002), method for water eutrophic state assessment came from 0Method for lake(reservoir) eutrophic state assessment and prescribe for technology classification0(State,2002), the result is in table 2. analysis for condition and cause of "algae bloom" Hydrologic conditions

The fulfillment of the Sanxia dam made the water level rise 10-30m, forming very long backwater region(from Sanxia dam to the Chongqing Chaotianmen dock) and reservoir gulf. The slope descent of Changjiang River decrease, with hydrologic situation and current state changing greatly, will make current velocity reduce . The current velocity will be very slow. The backwater peak the tributary that is in the scope of backwater region. Especially in the dry season, the amount of upriver water of reservoir diminish, water level in front of dam hoist ,and the current velocity of main breach peaked by the backwater is more less than that of natural river. The max current velocity in the period of calm water is 20cm/s, with the average 6 cm/s. In the dry season , the velocity of flow beyond the bank is always less than 2 cm/s.

In the dry season, when the level of sluice of the mainsrtream is 175m, the flux of the beach is 3700m^3/s , and the average current velocity of profile is only 0.25m/s,with that of the entrance is 0.16m/s which is more less than that in the natural situation. For the breach, when the water level is 175m, the current velocity decrease greatly. For examples, in the dry season, from Xiangxi River to jiangkou0Xiaojiang River ,the average velocity fall to the 0.009m/s and 0.006m/s relatively from 0.73m/s and 0.65m/s before the construction of the dam. In addition, the velocity beyond the bank is more less, basically, the flow does not flux, with the speed is close to that of the reservoir which is the pattern of lake. The coefficient of crosswise diffuse reduce to 0.10446m2/s from 0.1121m2/s. The hydrologic conditions of backwater region of several breach in the reservoir area are basically similar.

Climatatic conditions

Sanxia dam lies in the middle latitude subtropics, around it is Qinling Mountain , Daba Mountain, Wu Mountain and the other Mountains which can prevent winter cold current that comes from northwest infalling. The climate is warm and humid and four seasons are clear. There is abundant precipitation and sunshine. Summer is hot and winter is warm. The average annual temperature is 17°C~19°C,the average annual sunshine is 1330~1550h, and the rate of sunshine is only 30%~35%.In the March~June and September~December, the temperature is 6-25°C,and the water temperature is 10-24°C. It is a proper period to the growth of alga.

The sunshine plays a important role in the growth of alga. It is proved by the experiment that the growth of alga expedite with the increase of the sunshine intensity , in the range of definite sunshine intensity. While the sunshine intensity is less than 2010lux,the alga cells are able to propagate normally, and they grow best in the 2010lux-5010lux.Yet the growth speed slower markedly when it increases to 8000lux. When 10000lux, cells whiten, with the complete stop of growth. The appropriate temperature of alga is 15-22!. In spring and summer, there are averagely 67 days that the sunshine intensity of reservoir is in the range of 21000ux-50000ux with a fine weather and abundant sunshine.

Rich nitrogen and rich Phosphor

Analysis of the facilitated condition

Usually nitrogen and Phosphor is the limited factor in body of water for living creature growing .In international people think that rich nourishment density of TP is a 0.02 mgs/ L generally. When the density of the dissolubility Phosphor salt(PO43- P) which can be absorbed by living creature is < 5 ugs/ L, the Phosphor is the possible restrict nourishment salt that limits the water living creature growth(Martin *et al*,2012). Experiment results , the breeding of alga and the density of nourishment contenthave good relativity. The growth rate of the cell of alga decreases with the time growth and the nourishment density decreasing. he density of Phosphor which is the main nourishment chemical element in the nourishment liquid, especially the nitrogen decreases with the growth of the alga cell. The density of Phosphor decreases with the development time growth. Add the nitrogen when the density of nitrogen descend go to lowest,and

Table 1. The reservoir tributaries water China situation

Name of river	Time	Duration	Length of reach	Density of algae	Character
xiangxi river	2009,203 0406,001 0506	10-30days	20 km	2130×104 ind/L	the color of water is kellyÿdiatom and pond scum are the main category, mircocharacter and Asterionella are preponderant algae
daning riverÿbawu gorge0 shuanglongÿyinlongmen0m	2008,304 0506 20010506	10-20 days	25 km	1942×104 ind/L	the color of water is fawnÿthe water smells of fishyÿchlorella,Asterionella,peridinium0pand orina and microcystis are preponderant algae adu river
shennv river	2008,305 06 20090506	10-15 days	15 km	2380×104 ind/L	there is some red filaceous things in the waterÿand has peculiar smellÿPyrrophyta,chlorella0pandorina are the main category
baolong river	2008,304 20010506 0506	12-16 days	25 km	1790×104 ind/L	the color of water is kellyÿand the water smells of fishyÿmicrocystis are the main category,ÿCyciotella Kutz is preponderant algae
Fenghuangshan firth	2010ÿ305	7-10 days	10 km	2451×104 ind/L	the color of water is red or brownÿAsterionella and Peridinium are preponderant algaeÿalgae grain can be seen by naked eye

the stopped cell of diatom can continue to increase. The nourishment sources contenting of Yangtse area is abundant, the exhausting of nitrogen and in agriculture have great capacity ,add its long-term backlog, a great deal of nitrogen and Phosphor provide abundant nourishment for the diatom growth in the river. In the mixture place of subsidiary river and the stem flow, the formation return to the reservoir gulf, the total Phosphor , total oxygen density is widespread and higher, the nourishment material level of nitrogen and Phosphor attains standard level of enrich nourishment. The average density of total nitrogen, total Phosphor in the river which becomes the algae bloom are 3.42 mgs/ L,0.71 mgs/ L, the nourishment index number is 72.1,the nourishment class is at heavy degree.

Background

We observe that the burthen of nutriment in reservoir is comparatively high, especially the concentration of Nitrogen and Phosphor is close to that of ,even higher than it .There is a very important reason that is potential and active : the reservation of phosphorite in reservoir is 12 hundred millions tons which contains 17% of our country's ,and it is one of the six biggest phosphorite field. The reservation of phosphorite in xiangxi river drainage area is more than 7 hundred millions, and the river is the important area which produces phosphorite resource in our country, the concentration of total phosphor in Natural River mostly sources from the bedload of upriver. Therefore, the difference in valid proportion between Nitrogen and Phosphor of bedload floating substance in Sanxia reservoir is relatively big., and the rate of Nitrogen is about 2%,the Phosphor is about 80%,so the potential influence of Phosphor is bigger than that of Nitrogen. After establishing the Sanxia reservoir, the concentration of total phosphor will increase with the influence of bedload sediment.

The potential function of Phosphor is(Martin. *et al*,2012): the background value of Phosphor restrains the Phosphor's release that comes from floating substance, and the variety of pH have an impact on Phosphor's release. The pH value of arising and descending will change the Phosphor's release. As the water's disturbing time increase the quantity of Phosphor's release will increase gradually. After 24-25 hours, Phosphor's

Table 2. The result of assessment and value of monitoring in each sections

Tributaries	Section	Total nitrogen	Totapho sphorus	Diapha-neity	Chlorophy	CODmn	Integrated nutrition index	Integrated nutrition level
shennv river	daoche dam	4.56	0.95	0.5	1271	7.38	82.17	high
daning river	bawu gorge	3.07	0.47	0.5	1501	6.75	78.47	high
xiangxi river	xiakou firth	2.96	0.52	0.5	1245	5.63	74.18	high
baolong river	hongyan river	2.77	0.62	0.5	1027	5.27	70.33	high
xiao river	hekou firth	1.49	0.51	0.4	1358	5.31	65.04	middling
fenghuangsha n firth	baqian town	2.94	0.61	0.4	1336	5.87	67.56	middling
long river	fengdu town	4.12	1.03	0.5	1472	7.03	72.35	high
ruxi river	ruxi town	5.45	0.92	0.5	1395	6.82	77.32	high

release will balance. With the content of Calcium and iron hydronium increasing , they will restrain Phosphor's release in floating substance.

The pH value in the branch of reservoir presents neutral by measuring, so there is less Phosphor's release from bedload floating substance, and the rate in total Phosphor is about 0.5%~1%. The particulate Phosphor's release will weaken with the movement of bedload. However, the pH value presents acidic in market town water area, because the variety of pH redox potential and dissolved oxygen, the Phosphor's release from bedload increases.

Studying on bedload of Sanxia project,(Kuang, 2000), the test of Nitrogen and Phosphor's shape and LEEDs model,(Md. *et al*,2012).Nitrogen and Phosphor which has the character of potential and active will be cumulated when Sanxia reservoir runs in early days, and the quantity will be 170 thousand and 37.7 thousand tons respectively. Once the water environment is fitting, these Nitrogen and Phosphor cumulated in reservoir will release, and then they will increase the burthen of nutriment in reservoir.

Velocity of biochemic degradability and eutrophication

After water level of The Three gorges reservoir reach 175m, velocity of flow in flooded area is reduced to 1/5 of former velocity, Velocity of biochemic degradability is reduced to 1/2 of former velocity. Besides, flux of each month are not distributed averagely, the flux from May to September is 3.074×10"m^3 and flux from October to next May is 1.302×10"m^3, the quotiety of water replacing in reservoir is only 3.24. There is a negative correlation between quotiety of water replacing and accumulation of nutriment. The quotiety of water replacing in hydroelectric station of Gezhouba is 3.1, quotiety of abio-nitrogen accumulation is 55% and total phosphorus is 80% after storing water, but the adverse influence is not obvious.

Quotiety of water replacing from October to next may in The Three gorges reservoir is 3.4, accumulation of nitrogen and phosphorus is very obvious. Abundant organic matter, abio-nitrogen and phosphorus, which supply plenty of food to phytoplankton and zooplankton, is accumulated in reservoir area. Because velocity of flow descend, the category and amount will all increase, meanwhile, solvency of oxygen descend. It is proved by experiment that solvency of oxygen is less than other solute, the solubility of oxygen in 25°C saturated water is 8.1mg/L, if consuming action of oxygen happened, the dissolved oxygen will be zero soon, this is a menace to the quality of water in reservoir from march to June. Water in backwater which has abandon nutrition may become mephitic seasonally.

The analysis of pH

With the monitoring, there is a obvious pertinence between pH and amount of algae at the time of "algae bloom", in one cycle, the performance of pH is increasing, becoming stable (reaching maximum), descending, becoming stable again (between maximum and minimum). The Ph is 7.5 at the beginning, then grow up to 8.5 (the maximum is 9.0), at last it descend gradually. Ph in water of reservoir is mainly affected by the amount of CO in water, moreover, CO in water is affected by many factors, such as temperature, dissolved ion, microorganism and so on, but in eutrophied tributaries of reservoir, oxygen and CO are mainly affected by bio-course. Therefore, when amount of algae increase to a certain value, its amount and activity will be the main force for the change of pH. In the daytime, photosynthesis of algae is ascendant, amount of CO descend and pH increase. on the contrary, in evening , respiration of algae is ascendant and algae consume oxygen to make CO_2, that make pH descending. So there is a close pertinence among the change of pH, the amount and activity of algae (in different moment of vegetal cycle).

Marinated plant

After the Three gorges reservoir store water twice (water level are 135m and 175m), regorging flow make tributaries become backwater area which is about 5-25km long from middle part to frith. Except water exchanging of backwater area happened someplace in raining seasons, abundant nutriment in mainstream of the changjiang river accumulate in backwater area of tributaries, because of short flow and slow exchange of water. At one time, plenty of plants is decomposed in course of marinating, there is plentiful humic acid produced by decomposed plants which provide nutriment to eruptible vegetation of algae, that give a good condition for "algae bloom".

Vegetation mechanism of algae in slow-stream

In backwater area, there is a strong interaction between absorbing of N, P by vegetation of algae and consistence of N, P in water. The absorbing of P by algae will increase first and then descend rapidly when the consistence of N increase. (Khangaonkar *et al*,2010).There is a minimal value of P absorbing by algae when consistence of C and N are between 110 mg/L and 215mg/L in cell. The change of nutriment consistence in water will lead to change of absorbing of other nutriment, so, with consistence of N increasing, absorbing of P by algae will be stabilized in a changeless range. This is the reason why the period of "algae bloom" happened in the three gorges reservoir is short.

Temperature

When the "algae bloom" in the tributaries of reservoir happened, the air temperature is between 23! and 25!, the water temperature is between 21! and 23!, data in table 3 prove that water temperature has an important effect to vegetation of diatom and pond scum. Water temperature accelerate vegetation of algae and course of nutriment transference, that make dissolved oxygen descending and breath of algae increasing, so that algae cell can complete its own vegetation,(Huang *et al*,2010).

The distribution of nutrients

Measure phytoplankton growth is an important indicator of the relative limited by nitrogen or phosphorus, TN / TP = 16 phytoplankton growth relative constraints from nitrogen or phosphorus, the Three Gorges reservoir area and various tributaries of the main stream of

Table 3. Index of environment temperature factor when "algae bloom" happened

River	Water level increased (m)	State of backwater	Velocity of flow (m/s)	Water temperature	Sun light	Air temperature
xiangxi river	35	firth	0.05	21	enough	24
daning river	30	firth	0.04	21	enough	24
shennv river	25	riverway	0.04	22	enough	23
baolong river	25	riverway	0.03	22	enough	24
fenghuangshan river	45	firth	0.04	23	enough	25
xiao river	20	riverway	0.01	22	enough	24

nitrogen to phosphorus ratio distribution of nutrient concentrations have distinct. Overall water body in TN concentration in the 0.70-1.28mg of the / L,and the overall tributary water bodies TN concentrations in the 0.90-2.17mg / L, indicating that tributary water bodies by the river on both sides of the agricultural non-point source, and a living village, town sewage, aquaculture wastewater The impact of higher concentration. It follows that the Three Gorges Reservoir and tributaries TN, TP concentrations were higher overall, meet the growth of phytoplankton in need content.

CONCLUSION

"Algae bloom" happened in the three gorges reservoir is not only a simple physical chemical course, but also a integrated course including water conservancy(Kellner,2010), literae humaniores, physics, chemistry, biologic deposition, absorption, release and decomposing. Peculiar hydrological regime of reservoir is important condition for "algae bloom". The change of hydrological regime after storing water will affect the community and succession of biology in water ecosystem. In different hydrological regime, composing and amount of algae can be controlled by water level and residence time, which affect the course of water eutrophication. Descending of flow velocity is propitious for deposition of nutriment, but adverse for dilution of pollution in reservoir, so it provide good condition to vegetation of algae. In each part of reservoir, velocity of flow is unbalanced between mainstream and tributaries, center and side, crook and firth. The depth in different position is also unbalanced, that make different vegetation of algae in different tributary when in the same season and air temperature, that is an important cause of "algae bloom".

The amount of total P is large and its composition is complex in the three gorges reservoir. Bedload absorb particulate phosphorus (PP), dissociated particulate phosphorus, dissolved phosphorus and so on(Luo,2012). Cooperative effect formed by mechanism how phosphorus influenced vegetation of algae accelerate and strengthen the vegetation of algae, that lead to "algae bloom".

The cause of "algae bloom" in tributaries of the three gorges reservoir is controlled by amount of nutriment (P and N), hydrological condition, and climate condition strictly, besides, it has character like happening frequently, and disappearing rapidly.

The course of "algae bloom" forming and pollution in the three gorges reservoir is very complex, research about that is still underway at present, there are lots of problem which is waiting for being resolved by various subject.

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