

The Key Technology of Magnetic Bead Separation in the Flow Injection System

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Abstract-The magnetic bead separation system is a set of medical equipment which has a high degree of automation and separation. It has wide application prospect in our country, such as: Immunology, Cancer research, Transfer technique, Gene-technology, Histopathological, Clinical chemistry, Virology Microbiology and Medicine etc. This technique is mainly used for some kind of sample purification in some sectors (Hospital, Life science research center, Blood bank, drug test, Food inspection e.g.), such as some kind of Bone marrow and Blood cells, Cancer cells, Nucleic acids, Bacteria and other Microbes, separation pool

Keyword-magnetic bead, peristaltic pump driven

I. THE SELECTION OF MAGNETIC BEADS

The large magnetic bead was selected, usually, when the object have the characteristic of high concentration and low impurity. The diameters of large magnetic beads are usually from 1 to 10 μm , and apt to precipitate. Large magnetic beads needs appropriate mixing to stay suspended in the sample. But when the object has low concentration, large magnetic beads are hardly to suspension and evenly distribution. At this time, we usually select the diameters of small magnetic beads between 50 to 200 nm. Because of small magnetic beads can keep suspension and fully combine with object Rely on Brownian motion, so that we can to ensure the accuracy of trace analysis effectively. While, due to the weak magnetic of small magnetic beads, it is hard to recycle fully with simple device. And with the development of detection method, Medical testing on vitriol has higher and higher demand to the lower limit for the object. It also pushes the request more and higher to separate immune magnetic bend. But the current, our country is limited by technology. There is not any section to develop such high technique separation equipment, and then limit the development of medicine in vitriol immune detection technology, directly. We have large gap in the Chemiluminescence immunoassay technology and Electro encephalographic immunoassay technology, especially. According to this situation, we developed the flow injection magnetic bead separation system.

II. THE TECHNOLOGY OF KEY SYSTEM

The key technology project is involved as follows:

A. The peristaltic pump driven sampling system controlled by computer

It can be make sure the number can be precise control, and insure quantitative analysis and detection for all kinds of simple. The precision of peristaltic pump is must be considered in the design. The important factor to Peristaltic pump sample is "the ripple effect". The process is as follows: fluid into the peristaltic pump's head and savings in the area which between the two sticks, so the formation fluid pillow. Followed by a short block and formation fluid pillow once again, because of behind a pump pipe was blocked again. Such cycles, then form a ripple rather than a smooth fluid pulsation. If this phenomenon can't be considered, it will have much impact on the accuracy of the sample. As shown in figure 1.

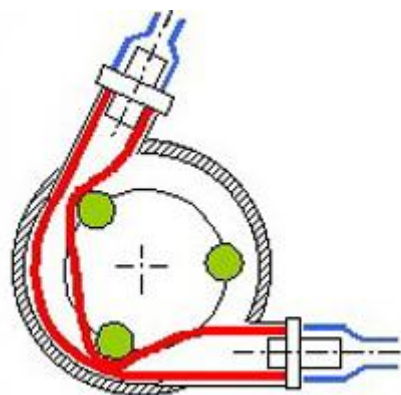


Figure 1. Peristaltic pump working principle diagram

Considering the effect, we should not only choose the pump which has low pulse but also to consider design a buffer device, when design a product. This kind of buffer device is belonging to the device that is reverse pump pipe extrusion. It can eliminate the pulse of the peristaltic pump with damping effect, through computer control the time and force of extrusion. In addition, the accuracy also relate to the precision of mechanical transmission system. Nonetheless, those errors have a track record of. We can correct it by software to make sure meet the requirements of precision.

B. This magnetic bead separation pool which is a magnetic field lines flat and intensity of magnetic field can change

In order to mark the different sample with diameter, we must use different intensity of magnetic field to separate these magnetic beads. For large magnetic beads, due to its quality magnetic is big. We can use smaller magnetic field intensity to separate it. Whole, small magnetic beads' quality magnetic is also small so that when we use the low intensity magnetic field they may be missed. Therefore it must be used which magnetic field intensity can be change for these magnetic steel device. Besides, there is a magnetic field intensity extreme area, according to the ordinary magnetic lines of magnetic force distribution. In this area, the magnetic field intensity is the largest and easy to cause the magnetic beads piles, then making it difficult to clean. As a result, considering the structure of magnetic steel and the gap between magnetic steel and separation of the pool can effectively solve the problem when we design it. At the time of pilot study, we study this kind of be called "groove" magnetic. It is a kind of single magnetic field source is bonding on magnetic materials which have a u-shaped groove. In this kind of structure, magnetic material becomes an expansion through bond with the magnetic poles. As the pole "S", extended around the pole "N", the magnetic field lines is dispersed and expanded to larger surface area which is form the magnetic field source. And due to one of the magnetic field source had been dispersing, the pole is extended. In this case, this is not applying to other magnetic field source, the direction of the magnetic field lines to be changed. This provides a flattened magnetic field. Under those decrease provides a larger area of an applied magnetic field. As shown in figure 2.

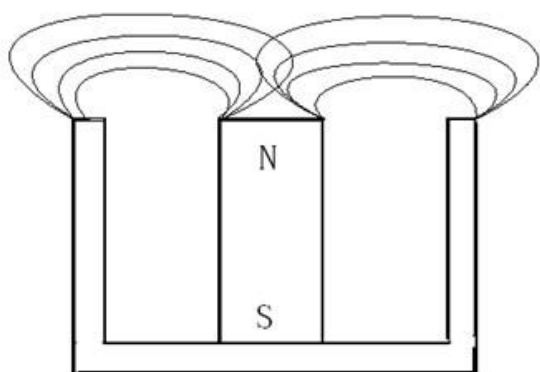


Figure 2. Composite magnetic steel structure diagram

C. (3) The simple of automatic blending cultivation system

In order to provide an appropriate environment and conditions to separate the test. We must to solve the problem what to deal with the simple automatically. For those reason, it should be through a progress which is marking the magnetic beads antibodies

and combining with antigen, before we design a program to deal with the simple according automatically. How to write the system is also a key problem in this project. In a general way, using magnetic beads immune method to protein and gene, this process to be done automatically. Only in this way can ensure the accuracy after the separation.

In this project, we have designed a computer controlled processing units, the sample cup can rotate any direction and around the axis of rotation. And that sample processing units have vibration feature for the mixing of the sample. It equipped with a needle that can move along the designed trajectory. This needle is use for quantitative and configuration the sample liquid. As shown in figure 3.



Figure 3. Sample processing units diagram

D. The system of injection needle automatic flushing (Inside and outside flush)

When we bulk separation of samples, often encounter the problem which is cross infection. Therefore, it is necessary to be considered that how to remove the flush on needle quickly and thoroughly. Firstly, we choose a special coating Teflon material which can solve the hang liquid problem. Secondly, how to design devices which can flush the sample needle automatically, it is the fourth key problem to solve in the process of project implementation.

III. THE CHARACTERISTICS OF THE SYSTEM

The flow injection immune magnetic bead separation system is based on analysis and research to the current international advanced equipment. A kind of method was summarized that is a new magnetic bead separation technology automatically. This method is according to the principle which magnetic particles and fluid separation to design a disk tubular magnetic beads flow separation pool. This kind of technology to improve the separation efficiency greatly, at the same time reduces the number of the separation of the sample greatly. This method is to separate the pool to provide a certain of speed fluid of separation, and it can increase

the speed of the magnetic bead separation greatly, at the same time shorten the separation time. Under this premise which can insure the degree of separation and the stability, it would greatly reduce the cost of instrument manufacturing. In the development of the instrument, we apply a technique that is high precision flow injection automatically control. Makes the separation device to quantitative control in manage, sample injection and separation process. And laid a solid foundation for realize full automation.

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