Introduction of Products

Outline of Automated Immunoassay System

HISCL-2000*i*

Takayoshi IZUMI

The Diagnostic System Development Division, Sysmex Corporation
4-4-4 Takatsukadai, Nishi-ku, Kobe 651-2271 Japan.

INTRODUCTION

Earlier Sysmex Corporation (Sysmex; Kobe Japan) had launched PAMIA Series immunochemical analyzers and ELSIA Series enzyme-linked immunosorbent assay systems, both of which are in use in many medical facilities. Nevertheless, there is a strong demand for assay systems with even higher sensitivity and specificity.

Recently at Sysmex we have developed automated immunoassay system HISCL-2000*i* (***Fig. 1***), which can meet this demand. This system uses a chemiluminescence enzyme immunoassay as its measurement principle, which has given the system better performance and higher-value-added features than the earlier systems. In developing this new system, we sought to improve the ease of use, which is a requirement in clinical laboratories, through simplified operation, shortened turnaround time (TAT), etc. I shall introduce here an outline of the HISCL-2000*i* system, and cite some basic data.

DEVELOPMENT CONCEPT

While developing the system, we used "chemiluminescence enzyme immunoassay, high sensitivity, short time of measurement, high speed processing, and system compactness" as the key concepts.

MAJOR SPECIFICATIONS

1. Name
1) Name: Automated immunoassay system
2) Model: HISCL-2000*i*

2. Application
This is an automated system that can identify and measure the concentration of substances like tumor markers, infection markers, hormones, etc in body fluids through enzymatic reactions in the presence of antigen-antibody complexes.

3. System components
1) Main analyzer unit
2) Information processing unit (IPU)
3) Reagent cart, IPU cart, etc

4. Specifications
Major specifications are given in ***Table 1***

Note: This article is translated and republished from Sysmex Journal 30, 155-161, 2007.

Fig. 1 *External appearance of HISCL-2000i*

Table 1 *Specifications of HISCL-2000i*

	Specification
Basic Principle	Chemiluminescence enzyme immunoassay
Analysis parameters	Infection-related parameters, tumor markers, thyroid hormone, coagulation factor markers, etc
Flow of measurement	2-step method, 1-step method, and D-1 step method*
Detector	Photon counting by photomultiplier
Throughput	Maximum 180 tests/hour
Analysis time	Approximately 17 minutes (from aspiration of sample to display of analysis results)
No. of samples that can be set	Assay samples: 50 (can be added as needed) Emergency samples: 6
Sample dispensing	Dispensing of serum/plasma by disposable tips (provided with the function of suction monitoring by a pressure sensor)
Required sample volume	10-30μL
No. of reagents that can be set	Up to 12 reagents
Reagent container cap	Automatic opening and closing
Addition of reagent	Continuous loading
Dispensing of reagent	Through probe (provided with liquid level detection function)
Consumables	Automatic supply system for disposable tips and reaction cuvettes (maximum number that can be preloaded: 500 each)
Operating unit	IPU
Quality control function	X bar control or L-J control Control materials: maximum 18
Memory function	Assay data: 30,000 samples Calibration curve: 2 lots × 50 parameters Quality control: 2 lots × 50 parameters × 180 points Various other set values
Output function	Host computer, printer (optional)
Installation mode	Floor-mounted
Size	Main unit: W 1100 × D 1005 × H 1355 mm
Weight	Main unit: about 353 kg
Power source	Main unit: 200 V/2000 VA

* Delayed 1-step method

TECHNOLOGY

1. Principle of measurement

The HISCL-2000*i* assay system uses chemiluminescence enzyme immunoassay as its principle of measurement, and measures chemiluminescence produced by the labeling enzyme, alkaline phosphatase. The flow of measurement depends on the parameter being analyzed. One can choose from 2-step method, 1-step method and D-1 step method. Either the sandwich assay or the competitive assay can be chosen for each method.
We have given below the flow of measurement in a 2-step sandwich assay as an example (***Fig. 2***). The reaction between the R1 antibody (or antigen) reagent and the test sample is carried out in the liquid phase, which enables efficient reaction in a short time. Besides this, elimination of interference from the background is achieved by washing efficiently and effectively during the B/F separation. Furthermore, the use of a high performance chemiluminescent substrate enables highly accurate measurements even with a small volume of test sample.
An example of measurement performance of the system is given below. ***Table 2*** shows the within-run reproducibility of an infection-related parameter and thyroid hormone parameter, and ***Fig. 3*** shows the distribution of HBsAg negative samples.

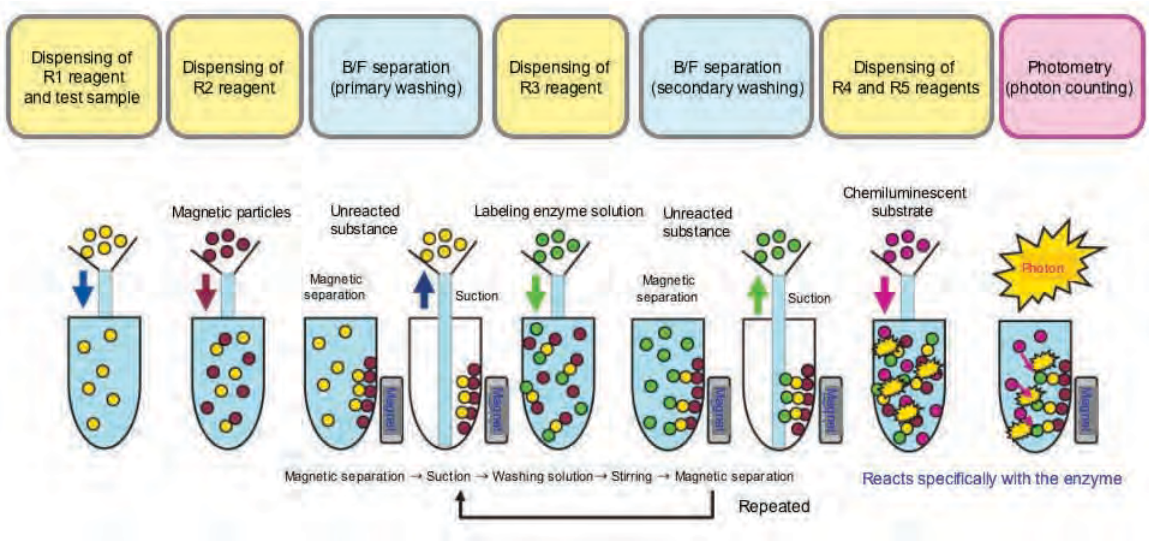

Fig. 2 *An example of flow of measurement in a 2-step sandwich assay*

Table 2 *Within-run reproducibility*

Analysis parameter	HBsAg (IU/mL)			TSH (μIU/mL)		
Sample	Low conc.	Medium conc.	High conc.	Low conc.	Medium conc.	High conc.
1	0.27	14.15	1,853	0.096	1.823	26.186
2	0.27	12.95	1,776	0.101	1.822	25.583
3	0.26	13.96	1,833	0.104	1.855	25.721
4	0.28	13.83	1,819	0.106	1.831	25.603
5	0.26	14.03	1,860	0.099	1.791	25.502
6	0.26	13.88	1,861	0.104	1.755	24.769
7	0.26	13.78	1,841	0.100	1.842	24.784
8	0.26	13.42	1,840	0.108	1.836	25.770
9	0.26	14.49	1,875	0.105	1.742	25.037
10	0.28	13.62	1,797	0.105	1.795	26.165
Mean	0.27	13.81	1,835	0.103	1.809	25.512
SD	0.01	0.42	31	0.004	0.038	0.507
CV	3.2%	3.0%	1.7%	3.6%	2.1%	2.0%

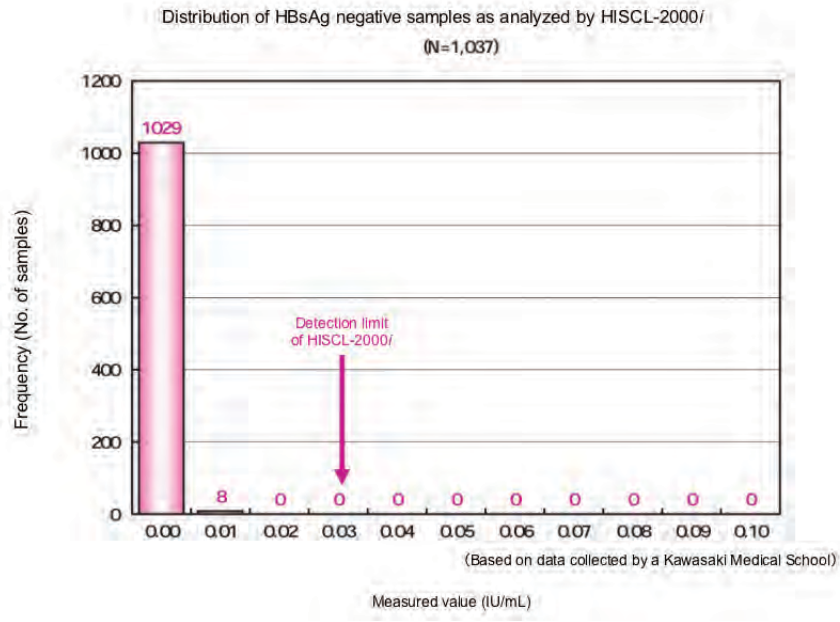

Fig. 3 *An example of the distribution of HBsAg negative samples*

Table 3 *Examples of sample volume (Unit; μL)*

	HBsAg	TSH	FT3	FT4	HCVAb	HIVAb	HTLV-1 Ab
Sample volume	20	30	10	10	10	10	10

2. Sample volume

We developed an assay system where sufficient reaction can occur even in a small sample volume, by doing the antigen-antibody reaction in the liquid phase before binding the antigen/antibody to magnetic particles. For example, the three parameters TSH, FT4, and FT3 could be measured with total sample volume as little as 50μL. Thus, the burden on the patient for retesting etc., could be reduced (***Table 3***).

3. Ease of use

1) Continuous loading function for reagents and consumables

For better ease of use, the new system has a continuous loading function so that the measurement operation need not be paused when a reagent or other consumable is exhausted. The R1 to R5 reagents are managed through barcode labels, and lots and positions are managed automatically.

(1) R1 to R3 for up to 12 reagents can be set up. Furthermore, several reagent containers can be set up for one parameter. Therefore, if a reagent gets exhausted during measurement, the machine automatically moves to the next container to continue the measurement. Moreover, with the automatic loading function provided, reagent containers can be replaced or added at any time, and the measurement need not be paused even when all of a reagent loaded for an analysis is exhausted (***Fig. 4***). Not only cooling function but a reagent container cap opening and closing function is also provided for the R1 to R3. This function opens the reagent cap during measurement and closes it when the required amount of reagent has been taken out. This minimizes evaporation and degradation of reagents, which makes it possible to keep reagents loaded in the analyzer at all times.

(2) Two containers each can be loaded for the R4 and R5 reagents, i.e., washing solution for B/F separation and washing solution for the probe line. When the reagent in one container is exhausted during measurement, the system automatically switches to the other container and continues the measurement, and the empty container becomes ready for replacement (***Fig. 5***). The R5 reagent is kept refrigerated within the system.

(3) Consumable materials like reaction cuvettes and disposable tips can also be added during measurement (***Fig. 6***). Both these items are automatically aligned by the system, and the operator need not carry out any cumbersome maneuvers for setting them.

2) Improved user-friendliness

The system is operated and controlled through the IPU PC. Visibility has been improved through the use of easily recognized icons that create an intuitive interface. Besides, the LCD monitor with touch panels offers different options, and almost all routine operations can be done by simply touching the screens (***Figs 7 and 8***).

Fig. 4 *Replacing R1/R3 reagent during measurement*

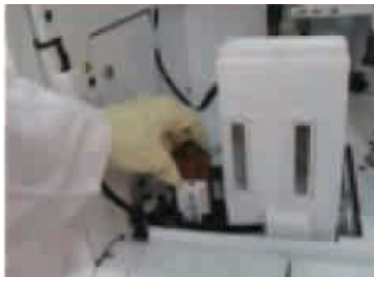

Fig. 5 *Replacing R4/R5 reagent during measurement*

Fig. 6 *Supplying reaction cuvettes*

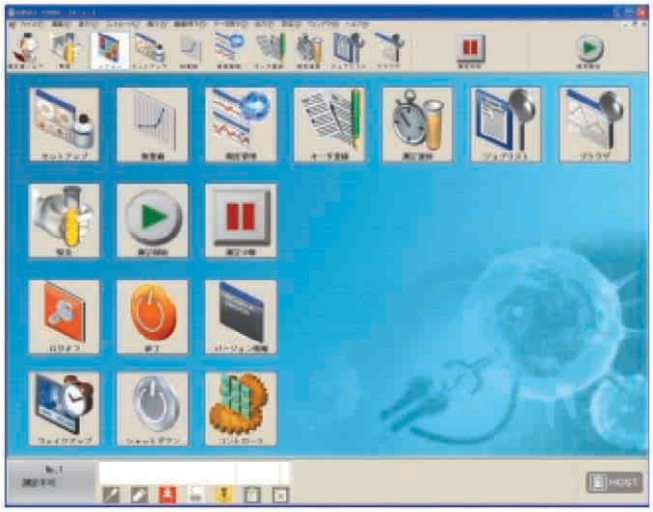

Fig. 7 *Main menu screen*

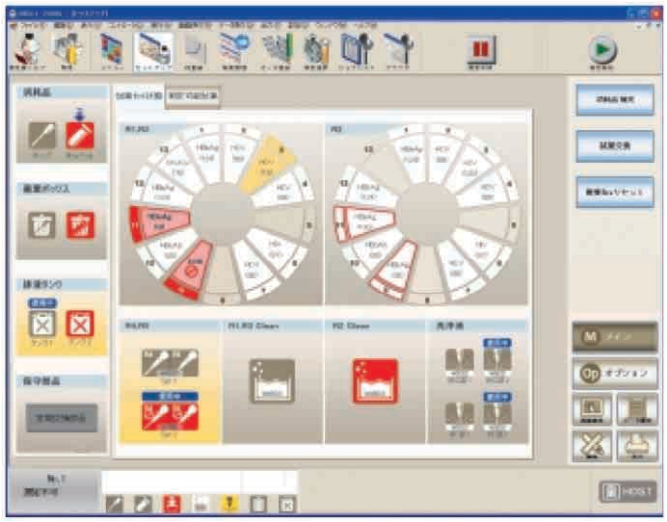

Fig. 8 *Setup screen*

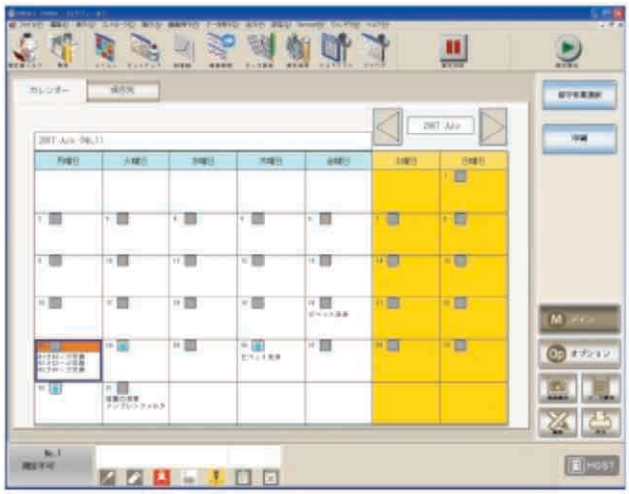

Fig. 9 *System maintenance scheduling screen*

(1) Management of maintenance schedules
Maintenance of analyzer systems used to be quite cumbersome. Therefore, the new system has a function where the maintenance schedule can be registered beforehand in a special Table (***Fig. 9***). The analyst can use this Table to set the time of startup (automatic startup) on any desired day of the week so that the system can be brought to the standby mode for measurement without going through cumbersome procedures before starting the testing.

(2) System shutdown
By shutting down the system in the reagent storage mode, you can keep it in an energy saving state where the system is first automatically washed and only the reagent refrigeration function is left on.

CONCLUSION

I have given above an outline of HISCL-2000*i*, a newly developed immunoassay system, citing the advantageous technologies incorporated in it, and giving examples of analysis performance. In spite of being compact, HISCL-2000*i* is capable of measurements with small volumes, high speed processing, and rapid reactions. The system is also equipped with many functions that improve ease of use, and I believe that it would be highly useful for testing in medium-sized hospitals and the like.
I would be very grateful to receive feedback on aspects to be improved, or any other requests, from users of the system.