

REPORT

Contract on Research Work
D05.033 of 20.01.2006
Customer: Faraday Lab Ltd

Subject of the agreement
"Research on the cavitation influence on change of half-life period"

An isotope ^{65}Zn has been chosen as active matter. Its decay diagram is Fig. 1.

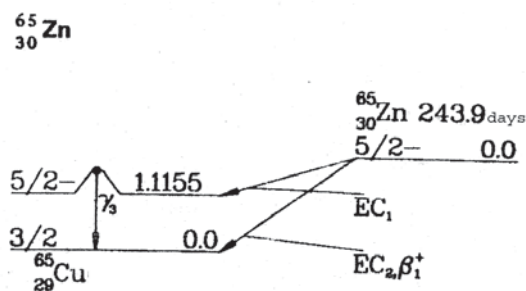


Fig. 1.

The given isotope has being chosen due to the fact that its half-life period of 243.9 days is much more than the time of measurements ($T_{\text{meas.}} < 48$ hours), therefore it is possible not to take into account its own change of activity. The diagram of decay is rather simple, and it is easy to measure the activity along the line of 1.115 MeV due to absence of background lines. This is radiation of a sufficiently large amount of energy, due to this it is possible not to take into account self-absorption. Zinc salt ZnCl_2 easily soluble in water and gives no sediment. It is important to note that zinc is also a carrier of an isotope. This is why the processes of deposition on the device's walls are the same for radioactive and non-radioactive zinc.

The research work has being carried out by several stages.

First stage (20.01.06 – 01.02.06)

Installation and start of the device. Actuating body is tap water. It is discovered that strong water pollution occurs. Yellow sediment is seeing in the samples after deposition.

In order to clean the device, it was disassembled and totally washed, the pump as well as the heater, by running water. A volume of the working chamber of the pump has being measured and amounted to 500 ml.

The device is filled with distilled water of 10 liter volume with addition of hydrochloric acid (pH of the solution is 3) and three working cycles has being carried out (15 minutes of heating and 45 minutes of cooling). It is discovered that, after this, the yellow sediment is still present in the solution. Obviously the sediment is caused by stripping of the turbine's surface due to cavitation. The presence of the sediment makes it more difficult to work with small concentrations of the investigated sample activity in the solution. The point is that particles of the solution sediment with deposited molecules of the active kind can move in the investigated sample of the solution and, thus, change indications of the spectrometer.

Due to this, a decision has being taken to work with stronger activity of the sample and measure small volumes of the sample (10 ml) at a distance of 70 mm from the detector.

Second stage (01.02.06–02.02.06)

The device was washed by distilled water again. In order to evaluate the processes which cause change of zinc concentration in the solution (for example, zinc deposition on the surface of the motor and heater), 10 liters of a solution of nonactive ZnCl_2 (with volume content of zinc of 450 mg/dm³ not taking into account the permanent 500 ml of the distillate in the motor) were prepared and primed into the device.

Two samples of the solution were taken: one - before priming and another - after two working cycles. The samples were given to VSEGEI (Russian Institute of Geological Sciences) for investigation.

The results of analyses shown in the attachment 1 demonstrated that change of Zn concentration in the solution was observed. It could be explained by zinc deposition on the device's walls. It is necessary to mention that zinc in the solution is not volatile and cannot vapor through the expansion vessel.

Third stage (28.02.06 – 02.03.06)

After the second stage the device was washed again by a lean solution of hydrochloric acid and distilled water. An identical solution of ZnCl₂ with addition of radioactive ⁶⁵ZnCl₂, with total activity 15MBq, was prepared. It should be mentioned that this addition

of the active zinc is negligibly small in relation to the natural zinc's mass.

Before start of priming, a control sample of the solution was taken (sample #0). Due to small amount of the solution sample (10 ml) a decision was taken to conduct measurements during a few working cycles (due to long duration of the measurements).

The results of activity measurements of the solution sample along the line of 1,115 MeV are given in Fig. 2 (in attachment 2 the results of processing of the measured samples spectra by a GeLi-detector). Null working cycle corresponds with the measurements before the device operation; this sample's activity is taken as 100%.

The results of two samples of chemical analysis of the nonactive solution ZnCl₂ are shown in the same figure (black squares). Here zinc concentration in the solution before the device operation is also taken as 100%.

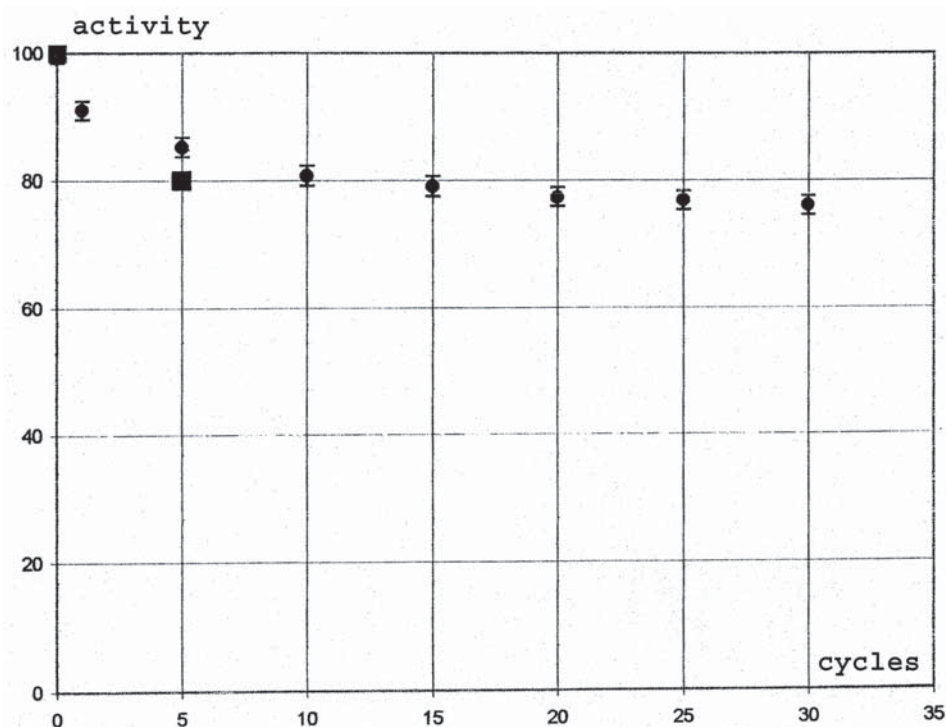


Fig.2

Note: Each working cycle consists of 15 minutes of the device operation and 45 minutes of the pump cooling. Total time of the device operation during the measurements was 7.5 hours which is less than the time mentioned in the requirements specifications due to the following reasons: change of activity significantly decreased during the last cycles. The total time of continuous measurements was more than 36 hours, and a long break was needed in order to continue the work, which could cause distortion of the results. The work has being carried out with high activity of the solution due to presence of admixtures not mentioned in the requirements specifications. After the measurements the whole radioactive solution has being poured into a special vessel and sent for disposal. The device has residual activity (up to ten backgrounds).

Conclusions

1. Change of the solution activity by more than 20% is observed during the process of the device operation.
2. A similar change of zinc content is observed in the samples of the nonactive solution (the analyses of VSEGEI).

The obtained experimental results require further analyses.

Head of Nuclear Reactions Laboratory
of Institute of Physics of St.-Petersburg State University

Lazarev V.V.

Attachment 1

Results of zinc concentration in nonactive solution.

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PROTOCOL # 70

DEFINITION OF CHEMICAL COMPOSITION

Customer: St.Petersburg State University

Date of analyses completion: 03.02.06

Object of analyses: Solutions

Methods of analyses: Atomic-emission analyses with inductively bound plasma

Correctness control: according to standard convergence

Measurement unit: mg/dm³

The measurements results are presented in Table 1.

Table 1.

Code of sample	Zinc content, mg/dm ³
1-1 (clear solution)	456
1-2 (yellow solution with sediment)	360

Head of CAL VSEGEI

/G.A. Oleynikova/

Attachment 2

Results of measurements of samples' activity.

**Sample 0 - initial solution, 10 ml, time of measurements – 3000 s,
height – 70 mm, DT – 0.27 %**

Report on peaks' parameters

28.02.06 19:00:01

Page 1

*** REPORT ON PEAKS' PARAMETERS

Detector	DET01
Sample's name	Sample title
Date of peaks analyses	28.02.06 19:00:01
First channel during analyses	1
Last channel during analyses	8192

Number of zone	Beginning of peak	End of zones	Centroid channels	Energy keV	Area	Error	Substrate
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№ Начало пика зоны Конец зоны Центроида каналы Энергия кэВ ПППВ Площадь кэВ Погрешность Подложка

1	100	112	103.41	19.43	0.75	5.21E+002	42.86	4.76E+002
2	162	176	170.81	31.96	0.29	1.12E+002	56.21	1.22E+003
M 3	384	407	389.80	72.67	0.69	8.63E+002	43.59	1.60E+003
m 4	384	407	401.53	74.85	0.70	1.62E+003	53.76	1.75E+003
M 5	445	477	454.33	84.66	0.85	6.72E+002	45.61	1.88E+003
m 6	445	477	467.93	87.19	0.85	2.43E+002	36.14	1.74E+003
7	1273	1288	1282.05	238.53	0.76	2.55E+002	46.46	8.15E+002
8	1884	1899	1890.48	351.64	0.94	1.32E+002	34.15	4.39E+002
9	2732	2759	2745.98	510.67	2.38	1.55E+003	57.53	5.86E+002
10	3125	3142	3134.20	582.84	0.31	8.68E+001	28.15	3.05E+002
11	3267	3286	3273.15	608.67	0.72	1.16E+002	31.12	3.47E+002
12	3703	3714	3708.43	689.59	0.48	1.12E+001	20.91	2.28E+002
13	4960	4974	4966.14	923.39	0.23	2.43E+001	20.82	2.09E+002
14	5983	6012	5996.85	1115.00	1.51	1.21E+004	111.86	1.45E+002
15	7842	7870	7856.68	1460.73	1.52	6.40E+002	26.42	2.25E+001

M = первый пик в области мультиплета

m = другой пик в области мультиплета

C = подогнанный синглет

M – first peak in multiplet area

m – another peak in multiplet area

C – trimmed singlet

Errors are 1.000 CKO

Note of Customer: Energy of 1115.00 KeV line is equal to 1.21E+004 in initial stage. In other tests of samples # 1-7 reported only this line of energy to compare changes.

Sample 1 - initial solution after the 1st cycle, 10 ml, time of measurements – 3000 s, height – 70 mm, DT – 0.26 %

Report on peaks' parameters

28.02.06 20:13:02

Page 1

***** REPORT ON PEAKS' PARAMETERS**

Detector **DET01**
Sample's name **Sample title**
Date of peaks analyses **28.02.06 20:13:02**
First channel during analyses **1**
Last channel during analyses **8192**

Number of zone	Beginning peak	End of zones	Centroid channels	Energy keV	Area	Error	Substrate
18	5980	6012	5996.71	1114.97	1.53	1.10E+004	106.89 1.47E+002

Sample 2 - initial solution after the 5 cycles, 10 ml, time of measurements – 3000 s, height – 70 mm, DT – 0.25 %

Report on peaks' parameters

28.02.06 21:24:28

***** REPORT ON PEAKS' PARAMETERS**

Detector **DET01**
Sample's name **Sample title**
Date of peaks analyses **28.02.06 21:24:28**
First channel during analyses **1**
Last channel during analyses **8192**

Number of zone	Beginning peak	End of zones	Centroid channels	Energy keV	Area	Error	Substrate
15	5980	6031	5996.77	1114.98	1.53	1.03E+004	102.07 1.02E+002

Sample 3 - initial solution after the 10 cycles, 10 ml, time of measurements – 3000 s, height – 70 mm, DT – 0.24 %

Report on peaks' parameters

28.02.06 22:21:29

***** REPORT ON PEAKS' PARAMETERS**

Detector **DET01**
Sample's name **Sample title**
Date of peaks analyses **28.02.06 22:21:29**
First channel during analyses **1**
Last channel during analyses **8192**

Number of zone	Beginning peak	End of zones	Centroid channels	Energy keV	Area	Error	Substrate
14	5981	6012	5996.72	1114.97	1.53	9.77E+003	101.13 1.53E+002

Sample 4 - initial solution after the 15 cycles, 10 ml, time of measurements – 3000 s, height – 70 mm, DT – 0.24 %

Report on peaks' parameters 01.03.06 08:28:20

*** REPORT ON PEAKS' PARAMETERS ***

Detector DET01
Sample's name Sample title
Date of peaks analyses 01.03.06 08:28:20
First channel during analyses 1
Last channel during analyses 8192

Number of zone	Beginning peak	End of zones	Centroid channels	Energy keV	Area	Error	Substrate
14	5981	6012	5996.73	1114.97	1.53	9.57E+003	100.77 1.17E+002

Sample 5 - initial solution after the 20 cycles, 10 ml, time of measurements – 3000 s, height – 70 mm, DT – 0.26 %

Report on peaks' parameters 01.03.06 15:10:11

*** REPORT ON PEAKS' PARAMETERS ***

Detector DET01
Sample's name Sample title
Date of peaks analyses 01.03.06 15:10:11
First channel during analyses 1
Last channel during analyses 8192

Number of zone	Beginning peak	End of zones	Centroid channels	Energy keV	Area	Error	Substrate
14	5980	6015	5996.74	1114.97	1.53	9.37E+003	101.55 1.20E+002

Sample 6 - initial solution after the 25 cycles, 10 ml, time of measurements – 3000 s, height – 70 mm, DT – 0.26 %

Report on peaks' parameters 01.03.06 19:50:46

*** REPORT ON PEAKS' PARAMETERS ***

Detector DET01
Sample's name Sample title
Date of peaks analyses 01.03.06 19:50:46
First channel during analyses 1
Last channel during analyses 8192

Number of zone	Beginning peak	End of zones	Centroid channels	Energy keV	Area	Error	Substrate
14	5980	6012	5996.71	1114.98	1.52	9.30E+003	99.84 1.35E+002

Sample 7 - initial solution after the 30 cycles, 10 ml, time of measurements – 3000 s, height – 70 mm, DT – 0.26 %

Report on peaks' parameters 01.03.06 23:01:16

***** REPORT ON PEAKS' PARAMETERS**

Detector	DET01
Sample's name	Sample title
Date of peaks analyses	01.03.06 23:01:16
First channel during analyses	1
Last channel during analyses	8192

Number of zone	Beginning peak	End of zones	Centroid channels	Energy keV	Area	Error	Substrate
14	5982	6014	5996.72	1114.97	1.53	9.21E+003	100.02 1.43E+002

**Head of Nuclear Reactions Laboratory
of Institute of Physics of St.-Petersburg State University**

Lazarev V.V.

Notes from The Customer

- 1. Total time of cavitation process for 30 cycles is 450 min or 7.5 hours.**
- 2. Power of cavitation drive here was about 10Kw only.**
- 3. Observed 20% changes of activity can not be explained only by sediments.**
- 4. More reliable results can be obtained for cavitation process of 50Kw power and more prolonged experiments.**
- 5. The body of the cavitation drive (the vortex chamber) in future experiments must be produced of inner surface hardening steel to avoid dashes in the solution.**

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