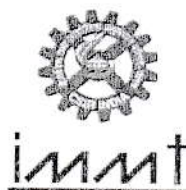
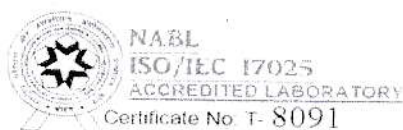


**Laboratory Scale Studies on *Iron* Removal  
Efficiency Individually on Supplied  
HIX 100™**

**Sponsor**  
**WIST WATER SOLUTIONS PRIVATE LIMITED**  
**(Brand name “drinkwell”)**  
**78 Biren Roy Road West, Kolkata 700061, W.B., India**

**October 2021**



**CSIR-INSTITUTE OF MINERALS & MATERIALS TECHNOLOGY**  
**(Council of Scientific & Industrial Research )**  
**Bhubaneswar -751 013**

## **FOREWORD**

It is a great pleasure for me to forward the final report (July 2021 - September 2021) on the project entitled "**Laboratory scale studies on iron removal efficiency from Ground water on supplied HIX-100™ resin in test set-up by WIST WATER SOLUTIONS PVT. LTD.**" The report incorporates the data generated on the water collected after passing through **HIX-100™** resin for iron. The report brings out the efficiency of said resins as investigated during lab scale experiment for the period July 2021 - September 2021. The report will be immensely useful to all concerned for related studies and understanding on efficiency of said resins.

**Prof. Suddhasatwa Basu**  
**Director, CSIR-IMMT**

## **ACKNOWLEDGEMENT**

The members of the project are thankful to team from WIST WATER SOLUTIONS PVT. LTD., Kolkata for providing necessary financial support in the execution of the project. Thanks are given to WIST WATER SOLUTIONS PVT. LTD for extending their cooperation in arranging the test set-up and related facilities.

The team is grateful to Prof. Suddhasatwa Basu, Director, CSIR-Institute of Minerals and Materials Technology, Bhubaneswar for his keen interest and constant encouragement.

Dr Arakshita Majhi  
Principal Scientist & Project Leader  
CSIR-IMMT, Bhubaneswar

***TEAM OF INVESTIGATORS***

**Dr. A. MAJHI (Project Leader)**

**DR. D. R. SATAPATHY**

**Dr R BOOPATHY**

**DR P M MISHRA**

**Dr MANISH KUMAR**

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Dr Arakshita Majhi  
Principal Scientist & Project Leader  
CSIR-IMMT, Bhubaneswar

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Dr Arakshita Majhi  
Principal Scientist  
Project Leader

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### CHAPTER: I

#### Laboratory scale studies on IRON removal efficiency on supplied HIX-100™ resin by WIST WATER SOLUTIONS PVT. LTD. (brand “drinkwell”)

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*Laboratory scale studies on iron removal efficiency individually on supplied  
HIX-100™ resin  
by  
WIST WATER SOLUTIONS PVT. LTD.*



## 1.1. Introduction:

Iron is found in both wastewater as well as ground water nowadays. Significant amount of iron is found in ground water in different locations where iron concentration has risen till 30 ppm or higher. Iron is an essential element in human nutrition. Estimates of the minimum daily requirement for iron depend on age, sex, physiological status, and iron bioavailability and range from about 10 to 50 mg/day. While a low **level of iron** isn't harmful in and of itself, **iron in drinking water** is classified as a secondary contaminant according to the EPA. **Iron** overload can lead to hemochromatosis, which can lead to liver, heart and pancreatic damage, as well as diabetes.

Treatment of iron from the drinking water stream is mandatory and it requires be reducing to less than 1.0 mg/L. As per our Indian Standards Specification for drinking water IS 10500:2012 the iron content should be below 0.3 mg/L and later modified in second revision in which the iron limit for drinking water is increased to 1 ppm.

The present detailed laboratory study of iron removal unit has been aimed to determine the removal efficiency of iron from iron contaminated water by *HIX-100™* in a pilot iron removal plant. *M/s WIST WATER SOLUTIONS PVT. LTD* had supplied the pilot iron removal unit capacity of 120 to 140 liters/hour and *HIX-100™* to CSIR-IMMT Bhubaneswar. Such study on a removal efficiency of iron shall give an idea about the *HIX-100™*.

*HIX-100™* acts as a catalytic media which helps iron in dissolved form to be transformed into suspended form by oxidation. Thus, iron can be oxidized, so long as a supply of electrons remains. *M/s WIST WATER SOLUTIONS PVT. LTD* is using this *HIX-100™* for removal of iron from contaminated water. CSIR-IMMT has not tested the physico-chemical properties of *HIX-100™*; the lab has only studied iron removal efficiency of synthetic iron doped water up to 30 ppm.

## 1.2. Experimental Setup

Treatment unit filled with *HIX-100™* resin of capacity 100 liters/hour approximately was supplied by *WIST WATER SOLUTIONS PVT LTD* and installed at CSIR-IMMT. Tap water was collected from CSIR-IMMT overhead tank through ground water pumping and about up to 30 mg/L of synthetic iron contaminated water was prepared for this study.

### 1.2.1 Methods:

Synthetic iron contaminated water was passed through **HIX-100™ resin** at 100 L/h for iron removal study for about 30 days as per the design and laboratory plant setup provided by WIST WATER SOLUTIONS PVT LTD. The experimental data are given in Table-1.1. The key water parameters of feed water and **HIX-100™ treated** water were characterized as per IS: 10500:2012 standards test methods. The results of key parameters are given in Table- 1.2. The resin packed bed laboratory setup is back flushed periodically.

### 1.3. Results and discussion

From the Table-1.1, it is observed that **HIX-100™** removes the iron from synthetic contaminated water up to 25 mg/l. But periodic back wash is required for the removal of iron from the water. Further, pH adjustment column was fitted before **HIX-100™ column**. *The pH must be adjusted to 6.5 to 7.5*. It has been observed that other parameters excluding iron content are not much affected.

**Table-1.1:****Removal of iron by HIX-100™ in synthetic water**

Date of Test	Iron content of water before filtration, mg/l	Iron content of water after filtration, mg/l	BIS 10500:2012 Limit, mg/l	BIS 10500:2012 Limit, mg/l 2 <sup>nd</sup> Revision	Dosing rate of 10% NaOCl, SPM	Flow Rate/hr	Run time, Hour
23.08.2021	8.45	0.15	0.30	1.0	NIL	150Litre.	6 hrs.
24.08.2021	9.23	0.10	0.30	1.0	NIL	150Litre.	6 hrs.
25.08.2021	10.25	0.09	0.30	1.0	NIL	150Litre.	6 hrs.
26.08.2021	12.63	0.12	0.30	1.0	NIL	150Litre.	6 hrs.
27.08.2021	10.23	0.11	0.30	1.0	NIL	150Litre.	6 hrs.
30.08.2021	15.75	0.13	0.30	1.0	NIL	150Litre.	6 hrs.
31.08.2021	16.23	0.24	0.30	1.0	NIL	150Litre.	6 hrs.
01.09.2021	15.03	0.15	0.30	1.0	NIL	150Litre.	6 hrs.
02.09.2021	17.28	0.21	0.30	1.0	NIL	150Litre.	6 hrs.
03.09.2021	14.29	0.12	0.30	1.0	NIL	150Litre.	6 hrs.
06.09.2021	23.00	0.09	0.30	1.0	NIL	150Litre.	6 hrs.
07.09.2021	21.50	0.11	0.30	1.0	NIL	150Litre.	6 hrs.
08.09.2021	24.75	0.31	0.30	1.0	NIL	150Litre.	6 hrs.
09.09.2021	25.90	1.01	0.30	1.0	NIL	150Litre.	6 hrs.
10.09.2021	25.69	1.18	0.30	1.0	NIL	150Litre.	6 hrs.
13.09.2021	26.48	1.24	0.30	1.0	NIL	150Litre.	6 hrs.
14.09.2021	27.98	1.31	0.30	1.0	NIL	150Litre.	6 hrs.
15.09.2021	26.58	1.14	0.30	1.0	NIL	150Litre.	6 hrs.
16.09.2021	27.66	1.15	0.30	1.0	NIL	150Litre.	6 hrs.
17.09.2021	27.95	1.10	0.30	1.0	NIL	150Litre.	6 hrs.
20.09.2021	28.00	1.25	0.30	1.0	NIL	150Litre.	6 hrs.

\*About up to 30 mg/L of iron contaminated water is prepared by doping iron (ammonium ferrous sulphate) with tap water

Source of tap water: CSIR-IMMT



**Table-1.1:****Removal of iron by HIX-100™ in Ground water**

Date of Test	Iron content of water before filtration, mg/l	Iron content of water after filtration, mg/l	BIS 10500:2012 Limit, mg/l	BIS 10500:2012 Limit, mg/l 2 <sup>nd</sup> Revision	Dosing rate of 10% NaOCl, SPM	Flow Rate/hour	Run time, Hour
06.10.2021	11.38	0.125	0.3	1.0	Nil	150	6
07.10.2021	12.94	0.096	0.3	1.0	Nil	150	6
08.10.2021	12.06	0.112	0.3	1.0	Nil	150	6

**Table-1.2:****Key parameters of Dug well water on iron removal (before and after passing through resin) as per IS: 10500:2012**

Parameter	Before passing through resin 06.10.21	After passing through resin 06.10.21	Before passing through resin 07.10.21	After passing through resin 07.10.21	Before passing through resin 08.10.21	After passing through resin 08.10.21
Iron, mg/l	11.38	0.125	12.94	0.096	12.06	0.112
pH	7.01	8.03	6.35	7.15	6.41	7.05
COLOR	25	<5	25	<5	25	<5
TDS, g/l	186.0	175.0	184.0	175.0	174.0	168.0
Conductivity, ms/cm	255	267	245	229	248	233
Turbidity, NTU	150	0.2	140	0.5	174	0.6
Alkalinity, mg/l	50.0	80.0	56.0	70.0	56.0	70.0
Total Hardness, mg/l	110.0	48.0	100.0	48.0	100.0	48.0
Sulphates, mg/l	5.62	1.42	6.45	1.32	5.23	1.25
Chloride, mg/l	45.0	29.0	32.0	28.0	33.0	28.0
Carbonate, mg/l	nil	nil	nil	nil	nil	nil
Calcium, mg/l	21.64	nil	18.43	nil	17.63	nil
Magnesium, mg/l	13.60	11.66	15.55	11.66	16.03	11.66
Sodium, mg/l	18.03	61.21	19.46	50.03	19.45	41.51
Potassium, mg/l	1.89	0.07	2.08	00.11	2.10	0.12

**Table-1.2:**  
**Key parameters of synthetic iron water (before and after passing through media) as per IS: 10500:2012 2<sup>nd</sup> Revision**

Parameters	25.08.2021		27.08.2021		30.08.2021		31.08.2021		01.09.2021		02.09.2021		06.09.2021	
	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After
PH	6.28	3.66	6.47	7.03	7.11	6.85	7.07	7.46	7.16	8.02	7.19	8.16	7.84	8.01
Color, Hazen Units	20	<5	20	<5	20	<5	20	<5	20	<5	20	<5	20	<5
Conductivity, $\mu$ S/cm	301	256	316	307	358	267	411	444	447	475	440	472	507	452
TDS, mg/l	234	196	237	232	276	210	301	326	339	362	330	356	385	341
Turbidity, NTU	19.4	1.0	16.0	0.2	17.6	0.5	24.6	0.8	26.0	0.6	28.0	0.2	35.1	0.2
Alkalinity, mg/l	48.0	0.0	58.0	74.0	84.0	60.0	60.0	84.0	78.0	94.0	76.0	92.0	98.0	90.0
Total Hardness, mg/l	50.0	20.0	50.0	28.0	52.0	30.0	48.0	26.0	50.0	30.0	52.0	26.0	78.0	26.0
Sulphate, mg/l	40.7	24.3	44.5	16.1	41.6	7.2	88.4	62.5	93.6	67.9	90.9	69.1	106.1	86.8
Fluoride, mg/l	0.06	0.04	0.06	0.05	0.07	0.05	0.07	0.04	0.08	0.05	0.09	0.05	0.08	0.04
Chloride, mg/l	29.0	36.0	29.0	35.0	29.0	34.0	28.0	35.0	30.0	37.0	29.0	35.0	30.0	37.0
Carbonate, mg/l	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL
Calcium, mg/l	6.4	NIL	5.6	NIL	5.6	NIL	6.4	NIL	5.6	NIL	6.4	NIL	16.8	NIL
Magnesium, mg/l	8.3	4.9	8.7	6.8	9.2	7.3	7.8	6.3	8.7	7.3	9.2	6.3	8.7	6.3
Sodium, mg/l	34.71	39.48	56.87	57.61	93.74	73.63	100.08	57.61	99.20	66.09	96.34	65.91	94.26	61.92
Potassium, mg/l	0.04	0.14	0.09	0.23	0.12	0.20	0.09	0.18	1.05	0.11	0.97	0.28	0.74	0.19



**Table-1.2:**  
**Key parameters of Real Ground water (before and after passing through media) as per IS: 10500:2012 2<sup>nd</sup> Revision**

Parameters	07.09.2021		08.09.2021		09.09.2021		14.09.2021		15.09.2021		16.09.2021		17.09.2021	
	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After
pH	7.17	8.29	7.15	8.25	6.96	8.26	7.24	7.38	7.36	7.40	7.54	7.11	7.34	7.04
Color, Hazen Units	20	<5	20	<5	20	<5	20	<5	20	<5	20	<5	20	<5
Conductivity, µS/cm	479	494	458	494	474	461	519	490	508	486	531	498	532	560
TDS, mg/l	360	379	345	368	356	344	389	368	371	360	406	371	399	415
Turbidity, NTU	34.8	0.2	35.9	0.3	34.2	0.3	37.5	0.3	38.3	0.4	37.6	0.4	34.5	0.4
Alkalinity, mg/l	12.0	88.0	60.0	74.0	46.0	84.0	70.0	66.0	66.0	46.0	86.0	62.0	76.0	68.0
Total Hardness, mg/l	48.0	30.0	50.0	28.0	50.0	34.0	50.0	30.0	48.0	28.0	48.0	32.0	50.0	26.0
Sulphate, mg/l	107.5	81.8	108.8	82.0	113.4	86.3	135.0	96.1	133.4	100.9	130.6	4.8	132.9	105.6
Fluoride, mg/l	0.05	0.03	0.04	0.03	0.05	0.04	0.06	0.04	0.08	0.05	0.09	0.04	0.06	0.05
Chloride, mg/l	28.0	36.0	28.0	35.0	29.0	36.0	28.0	35.0	29.0	36.0	29.0	30.0	30.0	37.0
Carbonate, mg/l	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL
Calcium, mg/l	6.4	NIL	5.6	NIL	6.4	NIL	5.6	NIL	5.6	NIL	5.6	NIL	6.4	NIL
Magnesium, mg/l	7.8	7.3	8.7	6.8	8.3	8.3	8.7	7.3	8.3	6.8	8.3	7.8	8.3	6.3
Sodium, mg/l	86.28	67.24	64.94	68.24	86.29	61.98	101.29	67.28	102.56	68.51	68.42	69.24	63.42	68.25
Potassium, mg/l	0.26	0.24	0.28	0.18	0.15	0.18	0.14	0.18	0.12	0.19	0.16	0.16	0.20	0.18

#### **1.4. Conclusion**

From the study the following conclusion may be drawn.

1. **HIX-100** resin and the system set-up provided by M/S **WIST WATER SOLUTIONS PVT LTD** has been tested for removal of total iron from synthetic water contains iron in the range of 8.45 ppm to 28 ppm.
2. The removal efficiency of **HIX-100** for removal of iron has been tested in synthetic and real ground water. The synthetic water was prepared by taking CSIR-IMMT ground water.
3. **A pH adjust column was kept after HIX-100 resin column.**
4. **HIX 100™** is found to remove iron satisfactorily within the limit of test conditions.
5. Periodic monitoring of iron removal plant is required and regeneration/change of media may be required following checking of iron level in treated water
6. At the time of installation, the iron removal plant, fresh **HIX-100** resin must be used and periodic washing may be required.
7. The process parameters of water in the report has been carried out as per BIS standard IS 10500:2012 2<sup>nd</sup> Revision.

**N:B- This test report is the property of CSIR-IMMT and only applicable to WIST WATER SOLUTIONS PVT LTD. This report cannot be shared/sub-contracted with any other parties/firms/person without prior permission of CSIR-IMMT**



सी.एस.आइ.आर - खनिज एवं पदार्थ प्रौद्योगिकी संस्थान  
**CSIR - INSTITUTE OF MINERALS & MATERIALS TECHNOLOGY**

वैज्ञानिक तथा औद्योगिक अनुसंधान परिषद  
Council of Scientific & Industrial Research

भुवनेश्वर-751013, ओडिशा, भारत, Bhubaneswar-751013, Odisha, INDIA

Ref.No-AM/10/2021/TSP

To Whom It May Concern

This is to certify that CSIR-IMMT Bhubaneswar tested resin **HIX™ 100** of WIST WATER SOLUTIONS PVT. LTD. (brand name "Drinkwell"), 78 Biren Roy Road West, Kolkata 700061, for iron removal at CSIR-IMMT, Bhubaneswar.

Iron removal column set-up filled with resin **HIX™ 100** of WIST WATER SOLUTIONS PVT LTD, was tested using feed water contaminated with different level of iron up to 28 ppm.

The media **HIX™ 100** was found to remove 25 ppm of iron efficiently within the permissible limit as per BIS 10500-2012 **2<sup>nd</sup> Revision**.

**A pH adjust column was required after removal of iron from ground water.**

Iron removal efficiency was tested in the laboratory scale in both synthetically prepared iron contaminated water & naturally occurring iron contaminated water.

N:B-This is only applicable to WIST WATER SOLUTIONS PVT. LTD.

*AM*  
20.10.2021

Dr Arakshita Majhi

Principal Scientist & Project Leader  
CSIR-IMMT, Bhubaneswar

डॉ. अराक्षिता माजी/Dr. Arakshita Majhi  
प्रधान वैज्ञानिक/Principal Scientist  
पर्यावरण एवं स्थायित्व विभाग  
Environmental & Sustainability Dept.  
सीएसआइआर-खनिज एवं पदार्थ प्रौद्योगिकी संस्थान  
CSIR Institute of Minerals & Materials Technology  
भुवनेश्वर/Bhubaneswar 751013