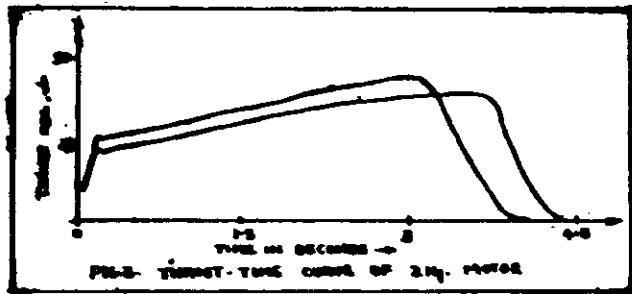


diffusion flame. The burn rate and combustion index are mainly controlled by the diffusion flame produced by the decomposition products of AP and binder⁴.



Ballistic performance of 20% HMX loaded HTPB propellant is shown in Fig.3.

100mm dia 200mm long motors weighing 2 Kgs. of propellant were static tested using 16mm dia throat. The thrust time curves show similar pattern with increased burn time for HMX propellant. Since the improvement in energetics is marginal (2%),

the extent of exact increase in energetics can be assessed only with bigger size motors.

4. Conclusion

Development of an environmental friendly high performance propellant containing 20% HMX was realized in sub-scale mixing. Processability and mechanical properties are quite comparable to HTPB propellant (blank). Burn rate and combustion index are found to be lower than that of the blank.

This novel formulation is expected to give a reduction of HCl smoke, 30% by weight in the exhaust, improved specific impulse by 4.2 secs (vacuum) and reduction in the flame temperature by 144° C.

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BENTHOS OF BEYPORE AND KORAPUZHA ESTUARIES OF NORTH KERALA

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Abstract: The benthos from Beypore and Korapuzha estuaries were studied for one year. Environmental features, sediment characteristics and organic carbon content were estimated. Benthic density was high during monsoon and postmonsoon in both the estuaries and Korapuzha was highly productive compared to Beypore. Pollution tolerant and indicator organisms have been identified.

1. Introduction

The rivers chaliyar and Korapuzha flow towards west from western ghats. The former joins the Arabian Sea at Beypore and the latter at Elathur 7 Km north of Calicut. Beypore estuary has been subjected to pollution due to the effluent discharged from the Rayon factory at Mavoor causing severe damage to the fishery of the area. Korapuzha river is very shallow and highly productive. Small scale retting is often noticed on the bank of the river. Information on the hydrographical features and the biological aspects from these estuaries are meager. Hence the present study was undertaken.

2. Materials and Methods

Monthly sampling was done during 1988 from 7 stations at Beypore and 3 stations at Korapuzha. S%o, T⁰, DO, grain size, organic carbon and benthos were estimated by standard methods.

3. Result and Discussion

Table 1a& b gives the average values of bottom T⁰, S%o and DO at different seasons in the two estuaries. At Beypore T⁰ did not show much variations between stations. During monsoon, fresh water regime prevailed at all stations except at St.1 and 2. High S%o was observed during premonsoon period throughout the area where as during postmonsoon Stns. 5-7 showed low S%o compared to other stations. James and Sreedharan (1983), Premchand et al (1987) and Natraj et. al (1987) observed saline intrusion upto > 20Km at Beypore estuary. Oxyty value was high at St.1 during all seasons compared to other stations. Grain size analysis showed the predominance of sand at all stations except at station 1, where silt dominated. Organic Carbon was high at all stations during premonsoon and low during postmonsoon. Comparatively St.1 showed higher values and St. 7 lower values.

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Table 1a & b - Seasonal averages of benthic density and environmental parameters at Beypore and Korapuzha

Stations	Table 1a						Table 1b			
	B ₁	B ₂	B ₃	B ₄	B ₅	B ₆	B ₇	K ₁	K ₂	K ₃
	<i>Premonsoon</i>						<i>Premonsoon</i>			
Total density (no/m ²)	63	330	175	215	239	117	1600	2784	1105	17967
T ^o C	30.15	31.30	31.30	31.6	31.85	31.80	32.39	30.34	30.64	30.36
S ^o /OO	32.20	28.40	27.52	24.98	21.98	18.67	17.62	32.49	32.58	29.55
DO (ml/l)	4.09	3.90	3.86	3.92	3.77	3.73	3.73	3.76	4.15	4.78
Sand %	55.25	92.36	80.96	86.18	84.87	99.05	96.89	74.11	2.89	27.53
Clay %	1.66	1.13	4.16	2.05	4.12	0.34	0.34	20.90	69.15	45.55
Silt %	43.08	6.52	14.88	11.76	10.86	0.61	2.74	4.99	27.96	27.02
Organic carbon (mg/g)	23.89	17.48	6.80	27.85	13.15	15.63	3.11	9.32	16.30	21.30
	<i>Monsoon</i>						<i>Monsoon</i>			
Total density (no/m ²)	1489	1005	916	1254	1626	1813	900	7998	459697	10389
T ^o C	27.70	27.32	27.00	27.25	27.10	27.15	27.40	28.05	28.70	28.55
S ^o /OO	31.33	6.93	0.86	0.57	0.09	0.09	0.00	24.90	29.80	25.60
DO (ml/l)	5.15	4.83	4.76	4.64	4.96	4.71	4.97	4.46	4.38	4.32
Sand %	25.50	87.60	90.28	92.25	59.87	98.91	92.00	16.66	36.79	17.39
Clay %	40.72	0.12	0.62	0.73	3.03	0.30	0.50	30.66	35.22	31.45
Silt %	33.77	12.62	8.70	7.03	41.59	0.77	7.50	52.66	27.98	51.15
Organic carbon (mg/g)	18.22	2.35	5.75	15.45	15.24	2.42	3.52	12.93	15.82	19.89
	<i>Postmonsoon</i>						<i>Postmonsoon</i>			
Total density (no/m ²)	1788	2150	498	164	347	1117	1865	6783	44486	173884
T ^o C	28.85	28.95	29.00	29.09	29.69	29.50	29.52	29.02	29.02	29.04
S ^o /OO	32.66	25.64	25.75	29.30	16.35	9.75	8.21	32.33	30.82	29.77
DO (ml/l)	4.09	3.96	3.56	3.62	3.75	3.80	3.93	2.79	2.51	2.98
Sand %	55.96	95.76	66.95	70.05	39.61	96.51	97.47	23.37	8.30	16.82
Clay %	11.41	1.57	0.61	5.57	3.64	2.62	0.63	48.61	54.51	39.77
Silt %	32.62	5.01	10.94	24.35	6.95	0.75	1.96	28.01	37.13	43.41
Organic carbon (mg/g)	7.63	4.54	5.72	7.18	6.00	3.93	3.14	10.55	14.63	16.12

At Korapuzha not much horizontal variations in hydrographic parameters were noticed. Oxyty values were high during monsoon and low during postmonsoon. Grain size analysis showed high percentage of sand and low percentage of clay and silt during premonsoon. The organic carbon content was high during monsoon except at station 1 and high values coincided with the high percentage of fine grained sediment.

Table 2 gives the check list of groups/species. At Beypore the benthos comprised of 49 groups/species. Out of 23 species of polychaetes recorded, only *Prionospio polybranchiata* occurred in considerable numbers at all stations. *angustrosyllis constricta*, *endronereis aestuarina*, *Glycera convoluta*, *Heteromastides fidus*, *Paraheteromastus tenuis* were noticed at 6 stations and the species *Lycaeus indica*, *Perineris cavifrons*, *Glycera alba* were recorded from 5 stations. *Nephtys dibranchia*, *Lumbriconereis simplex*, *Pista indica*, caprellidae were recorded from 3 stations in small numbers. The rest of the species appeared in one or two stations in lower numbers. Remani et al (1983) reported the species *Prionospio polybranchiata* and *Paraheteromastus tenuis*

from the retting ground and sewage polluted area of Cochin backwaters and stated that these are indicators of organic pollution. Among amphipods *Corophium triaenonyx* and *Grandidirella gilesi* ranked 1st with considerable numbers at all stations. *Quadrivisio bengalensis* was absent only at station 3. Rest of the species showed lesser abundance and discontinued spatial distribution. Among other groups decapods and *Villorita cyprinoides* were present at all stations. Amphioxus, flat worms, juvenile fish, harpacticoides, *Paphia papillions*, and *Balanus* sp. appeared only in the river mouth.

Population was high during monsoon and postmonsoon months compared to premonsoon which may be attributed to the availability of food sources and nature of the substratum in addition to their ability to tolerate a wide range of salinity. The presence of one group of animal at a particular station and their absence at other stations indicate the strong preference of the fauna towards the particular type of substratum and environmental conditions. Korapuzha is highly productive compared to Beypore. The total benthic density was high during monsoon and

Table 2. List of groups/species encountered at Beypore and Korapuzha

Sl. No.	Groups/Species	B ₁	B ₂	B ₃	B ₄	B ₅	B ₆	B ₇	K ₁	K ₂	K ₃
1	Aphroditidae	-	-	-	-	-	-	21	-	262	-
2	<i>Ancistrosyllis constricta</i>	-	21	63	21	105	63	229	460	105	42
3	<i>Lucasius indica</i>	63	-	42	-	84	292	417	-	-	-
4	<i>Dendronereis aestuarina</i>	210	63	21	135	-	104	63	791	366	335
5	<i>Perenereis cavifrons</i>	42	-	-	42	167	104	229	84	-	21
6	<i>Nephtys dibranchia</i>	21	-	21	84	-	-	-	188	-	-
7	<i>Eunice tubifex</i>	21	-	21	-	-	-	-	-	-	-
8	<i>Diopatra neapolitana</i>	-	63	63	-	-	-	-	1106	504	8286
9	<i>Lumbriconereis simplex</i>	-	131	84	-	-	84	-	21	-	-
10	<i>Lumbriconereis notocirrata</i>	-	-	27	-	-	-	-	-	-	-
11	<i>Lumbriconereis polydesma</i>	-	21	-	-	-	-	-	-	-	-
12	<i>Goniada incerta</i>	323	-	-	-	-	-	-	-	42	-
13	<i>Glycera alba</i>	21	-	-	-	-	-	-	42	-	-
14	<i>Glycera longipennis</i>	-	-	-	-	-	-	-	42	84	-
15	<i>Glycera convoluta</i>	63	105	42	249	286	84	-	-	84	-
16	<i>Prinospio polybranchiata</i>	2132	1458	1206	2210	1336	5046	459	1668	1440	354
17	<i>Prinospio pinnata</i>	-	-	-	-	-	-	-	-	104	210
18	<i>Heteromastus similis</i>	-	-	-	-	-	-	21	-	-	-
19	<i>Heteromastides bifides</i>	42	-	42	84	185	21	146	105	21	-
20	<i>Paraheteromastus tenuis</i>	126	-	42	84	104	210	243	105	21	-
21	<i>Pista indica</i>	-	42	42	-	-	21	-	167	-	-
22	Hesionidae	-	21	-	-	-	-	-	-	-	-
23	<i>Owenia</i> sp	-	21	-	-	-	-	-	21	-	-
24	<i>Nais</i> sp	-	-	-	-	-	-	-	21	-	-
25	Notopygos	-	-	-	-	-	-	-	-	84	-
26	<i>Polydora</i> sp	-	-	-	-	-	-	-	354	-	920
27	<i>Polydonomotus</i> sp	-	-	21	-	84	-	-	646	84	-
28	Phyllococe	-	-	-	-	-	-	-	-	-	21
29	<i>Capitella capitata</i>	63	-	21	-	84	-	-	21	-	-
30	<i>Corophium triaenonyx</i>	1475	521	190	333	2854	398	438	900085	1902937	538819
31	<i>Quadrivisia bengalensis</i>	167	126	-	84	125	1667	1458	47822	20416	152
32	<i>Grandidrella gilesi</i>	604	272	315	104	146	3866	454	4235	5439	5796
33	<i>grandidrella honneri</i>	63	63	105	-	21	-	105	529	292	1441
34	<i>Melita zeylanica</i>	-	42	21	21	63	125	-	398	819	1021
35	<i>Eriopisa chilkensis</i>	-	21	-	42	21	-	-	189	104	84
36	Carpillidae	21	-	21	-	-	21	21	126	-	-
37	<i>Apsudes chilkensis</i>	-	-	-	-	-	-	42	1349	88	230
38	<i>Apsudes gymnophobium</i>	-	63	-	-	-	-	21	2082	4812	15559
39	<i>Cirrodinia fluviatilis</i>	314	168	1000	42	-	-	-	105	84	100
40	Anthuridae	21	-	-	42	42	210	166	21	42	21
41	Decapoda	21	63	126	21	42	21	126	21	42	21
42	Alpheids	-	-	-	-	-	-	-	21	-	42
43	Sergestidae	-	-	-	-	-	-	21	21	-	42
44	Myxal	63	-	-	105	-	-	-	-	-	-
45	Chironomid	-	-	-	-	-	63	21	-	-	-
46	<i>Balanus</i> sp	-	126	-	-	-	-	-	-	-	21
47	Juvenile fish	21	-	-	-	-	-	-	63	-	-
48	Flat worm	21	-	-	-	-	-	-	167	21	63
49	Amphioxus	21	-	-	-	21	63	-	-	-	-
50	Harpacticoides	-	-	-	-	21	-	-	-	-	-
51	Nemertodes	-	-	-	-	21	-	-	63	733	475
52	Echinoderms	-	-	-	-	-	-	-	72	42	-
53	<i>Villosa cyprinoides</i>	7521	13163	1399	1211	1400	2777	1034	42	-	-
54	<i>Pappua poppillions</i>	21	-	-	-	-	-	-	21	-	-
55	<i>Modiolus</i> sp	-	42	-	-	-	-	-	10048	1019	-
56	<i>Pendora fluxosa</i>	-	63	-	-	-	-	-	63	-	-
57	<i>Cardium</i> sp	-	-	-	-	-	-	-	21	-	-
58	Unidentified bivalve	-	-	-	-	-	-	-	-	-	-
59	Gastropoda	-	42	21	-	-	-	-	-	-	-

postmonsoon period. The substratum was clayey silt through out the period. Out of 50 groups/species encountered, amphipods dominated in this estuary. In general, benthic density was high during monsoon and postmonsoon in both the estuaries. Higher abundance of zooplankton at Korapuzha compared to Beypore was reported by Haridas (1982). Fourteen species of polychaetes, five species of amphipods, two species of tanaidaceans, one species of isopod, decapods and nematodes were common to both the estuaries. The chironomid larvae a pollution indicator organism was noticed only at the riverine zone of Beypore. The presence of sentinel organism *Villorita cyprinoides* at Beypore, irrespective of seasons and stations is noteworthy. The pollution tolerant polychaete species *Dendronereis aestuarina* and *Lycastis mdica* and the pollution indicator species *Prionospio polybranchia* and *Paraheteromastus tenuis* were also present at Beypore.

The environmental parameters and sediment characteristics help to sustain a high density of benthos at Korapuzha. Low density at Beypore may be due to the cumulative effect of the effluent discharged from the Rayon factory at Mavoor. Saradadevi and Venugopal (1989) noticed low benthic density and biomass in and around the effluent discharge site in the upper reaches of Periyar river and increase in density and diversity towards down stream with increase in dilution there by reducing the effect of

pollutants. Nair et al (1984) made similar observations at Ash-tamudi estuary.

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