is observed that the bulk-CdS powder does not emit any light and look black whereas the nanocrystalline samples emit red light. Our CdS nanocrystallites are unique of their kind – which clearly demonstrates the possibility of light emission only from such nanocrystallites of average size 5.0 nm. Thus, our CdS nanocrystalline materials can now be used as an UV sensor.

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K. K. NANDA
S. N. SARANGI
S. N. SAHU

Institute of Physics,
Bhubaneswar 751 005, India

Xylanase production and its impact on bleaching of hardwood kraft pulp

Traditionally, wood pulp used for paper making process is bleached using chlorine or its derivatives such as calcium hypochlorite and sodium hypochlorite to remove residual lignin present in the pulp. The main cause for brown colour of the pulp is the presence of residual lignin. Chlorinated organic compounds produced during conventional pulp bleaching are detrimental to environment and highly resistant to microbial degradation. Chlorinated organic compounds are mainly responsible for the discharge of AOX (adsorbable organic halogens) in the receiving waters[1]. Modern techniques such as prolonged kraft cooking, bleaching with hydrogen peroxide, oxygen, enzyme (xylanase) and ozone have been introduced recently to reduce the production of chlorinated organics during bleaching[2]. Among the new techniques, enzyme bleaching is becoming important in the recent past due to its environmentally friendly nature[3–5]. In kraft pulping, xylan, one of the major components of wood hemicellulose, is solubilized during the initial stages of the cooking period and in the final stages of pulping, xylan gets precipitated and redeposited on the secondary cell wall of the fibre. The redeposited xylan acts as a bonding material between residual lignin and cellulose present in the pulp[4]. Therefore, limited hydrolysis of the xylan present in the pulp by hemicellulase enzyme like xylanase was found to improve the bleaching performance, reduce AOX discharge and active chlorine consumption in bleaching process[3,6–10]. Therefore, efforts were made to produce xylanase enzyme and apply to mill-made hard wood kraft pulp in our laboratory.

Several fungi were isolated from the stored bagasse from the bagasse yard at TNPL mill site using malt extract agar medium. All the fungi were screened for xylanase production using culture medium containing 1% xylan from bagasse chemical pulp[11], 0.5% peptone, 0.2% $(NH_4)_2SO_4$, 0.5% K_2HPO_4 and tap water, in orbital shaking incubator (160 rpm) at room temperature. Xylanase enzyme assay was carried out using 1% 4-*o*-methylglucuronoxylan from birch wood (7,500 Roth Germany) as a substrate in 50 mM sodium citrate buffer, pH 5.4 and temperature 40°C (ref. 12). Among the various fungi screened for xylanase activity, a wild strain of *Trichoderma* sp. (TNPL-192) was found to produce more enzyme when compared to others and the same was used for further studies.

To improve the xylanase production all the media components and conditions such as pH and temperature were optimized using Graeco-Latin technique. Various less expensive and easily available ligno cellulose substrates were tried and it was found that corn cobs, as carbon source, could induce substantial amount of xylanase production by *Trichoderma* sp. Xylanase production was scaled up in 5 l (operating volume 3.7 l) laboratory fermenter (Bioengineering Switzerland) using optimized medium (Table 1). The initial pH of the medium was 6.5 and allowed to vary during fermentation period. Temperature and PO_2 were maintained at 28°C and 8.0% saturation respectively. After 6 days of cultivation the crude culture filtrate had a xylanase enzyme activity of 108 XU/ml.

Table 1. Optimized conditions for the production of xylanase enzyme by *Trichoderma* sp.

Parameter	Condition
Corn cobs	15.0 g/l
Peptone	15.0 g/l
$(NH_4)_2SO_4$	2.0 g/l
KH_2PO_4	5.0 g/l
$MgSO_4$	0.3 g/l
$FeSO_4$ (7 H_2O)	0.25 g/l
pH	6.5
Temperature	Ambient
Tap water	1000 ml

Crude xylanase enzyme produced in the fermenter was used for pretreatment of mill-made hard wood kraft pulp (kappa no. 17.8; brightness 24.4% ISO; viscosity 12.6 cps) prior to chlorination stage in CEH bleaching (C: chlorination, E: extraction and H: hypochlorite). The enzyme pretreated pulp along with control was bleached in the laboratory under identical conditions. The pulp properties such as kappa number and viscosity were performed as per TAPPI test methods T 236 and T230 respectively and brightness using Elrepho 2000 as per ISO 2470.

The bleaching results including bleaching conditions are presented in Table 2. From the results it is clear that xylanase enzyme pretreatment improves the bleaching response of hard wood pulp. Overall there is 4.4% ISO brightness increase over the control and

Table 2. Influence of xylanase pretreatment on bleachability of hard wood kraft pulp

Particulars	Control	Enzyme treated
Enzyme stage (X)		
Xylanase enzyme applied XU/g	–	10
pH	6.0	6.0
Chlorination stage (C)		
Chlorine as Cl_2 % applied	3.20	3.20
Consumed	3.13	3.06
Final pH	2.2	2.1
Extraction stage (E)		
Alkali as NaOH % applied	2.00	2.00
Consumed	1.42	1.26
pH Initial	12.0	12.2
Final	11.5	11.6
Hypo stage (H)		
Hypo as Cl_2 % applied	1.92	1.92
consumed	1.38	1.70
pH Initial	9.8	10.2
Final	8.6	8.7
Final brightness % ISO	77.3	81.7
Brightness gain	–	4.4
Viscosity cps	5.4	5.0

Bleaching conditions:

	X	C	E	H
Temperature (°C)	50	Amb	60	40
Time (min)	120	30	60	120
Consistency (%)	10	3	8	8

enzyme pretreatment has insignificant influence on viscosity of the pulp, which indicates that it did not have much pure cellulose degrading enzymes. Generally, xylanase enzyme pretreatment is used to improve the brightness target in total chlorine free and elemental chlorine free prebleaching or to reduce the active chlorine components during the bleaching by reduced chlorine dosage to save chemicals and decrease the AOX production. In the present study we have applied the xylanase enzyme prebleaching concept to improve the final brightness of the pulp without any additional chemical charge Similar to the present study, enzyme pretreatment before the peroxide delignification/bleaching is also found to improve the final brightness of various pulps[9,13].

From the above results it is concluded that introduction of xylanase enzyme pretreatment stage, (10 XU/gram of pulp) in CEH bleaching of hard wood kraft pulp before chlorination stage would improve final brightness of pulp without any additional chemical charge, resulting in lower pollutant generation. The pulp properties are unaffected.

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S. CHINNARAJ
K. S. RAJESH
N. R. MOHAN RAO

Tamil Nadu Newsprint and Papers Ltd., Kagithapuram 639 136, India

Greater fertility of *Drosophila ananassae* flies possessing high number of sternopleural bristles

Drosophila ananassae, a cosmopolitan and domestic species, is of common occurrence in India. It occupies a unique status in the whole of genus *Drosophila* due to certain peculiarities in its genetic behaviour[1]. The work done on population genetics, behaviour genetics and crossing-over in *D. ananassae* by Indian workers has been reviewed by Singh[2]. We conducted investigations on quantitative genetics with respect to sternopleural bristle number in Indian *D. ananassae*[3–5] and the results have shown that there is a genetic heterogeneity in Indian populations of *D. ananassae* with substantial amount of additive genetic variation for this trait